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Distribute Costs on Each Job

Manufacturer of Electric Steel Castings Makes Detailed Tabulation of Expenses Including Minor Materials to Each Job—How Work Is Routed Through the Shop

BY E. C. BOEHRINGER

OBVIOUSLY there can be no standard construction costs on all 6-cylinder automobiles nor on all 12-room residences. From the same viewpoint—that of cost—a 20-pound casting is not always a 20-pound casting to the Nugent Steel Castings Co., Chicago. One casting of this weight may lend itself easily to steel foundry practice, give a high yield, a low labor cost and in every way prove a profitable job. Another casting of the same weight may be difficult and costly to handle from the coreroom to the final inspection, give a much lower yield, require the employment of far more material and slow down the pace of the entire foundry. Therefore, to arrive at a flat price per pound on all castings of a given weight would result in a disproportionate distribution of labor and material costs and overhead. It would be misleading to the foundry and unfair to the buyer of castings. Realizing this the Nugent company has developed an elaborate, yet not burdensome, cost system whereby it keeps before it at all times a running and complete picture of all its cost factors.

This cost system, which is the controlling factor through the plant from the unloading of steel scrap to the shipment of the finished casting, is in consonance with the general layout of the plant. The straight line idea prevails throughout, and from the merging of the raw materials to the making of the metal, cores and molds, the pouring, shaking out and cleaning, there is no retracing of steps. The Nugent plant which

ALL WORK IS CLASSIFIED AND ASSIGNED TO A DEFINITE SECTION, BUT MOVES IN A STRAIGHT LINE THROUGH THE PLANT, WHICH ASSISTS IN THE KEEPING TRACK OF PRODUCTION

was described in THE FOUNDRY, June 1, 1919, has the advantage of having been built as a unit and not as a succession of enlargements, and therefore represents the most modern in steel foundry practice. The products are small and medium weight steel castings for motor trucks, agricultural implements, railroad equipment, road building machinery, printing presses, mining machinery, oil well supplies, conveying machinery and allied products. Thin-section castings are a specialty of the Nugent company.

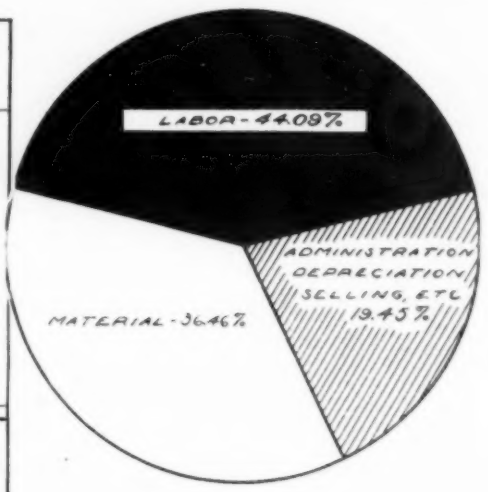
Where the average foundry usually unloads its scrap on one huge pile and attempts only in a makeshift manner once or twice a year to reconcile its inventory, the Nugent company handles each carload of scrap individually. Just outside of the furnace end of the foundry building is a row of bins capable of housing a six-month supply of scrap, each bin having a capacity of one carload. All scrap is purchased on analysis and each car is analyzed before unloading. These data are used by the chemist in making up the furnace charge. Daily reports by the melter show the amount taken from each bin. When a bin is empty the withdrawals from that bin are totaled and checked against the original weight bought and paid for, and if any shortage or overage should exist it is detected and absorbed arbitrarily at once. This insures that costs will be taxed as accurately as is possible with the materials consumed, and eliminates the possibility of a shortage at the end of a fiscal period. Since this system has been in vogue the year's close is approached with the knowledge that the material charges made against cost during the year will correspond so closely with the amount actually expended that a shortage is practically impossible. The correct distribution of all items of expense is considered of such importance that the cost of unloading material from cars is charged against the cost of the material itself.

A departmental cost system reveals at the end of each month exactly where every dollar's worth of material and labor has gone. Running inventories are maintained and since costs are charged only with the exact material consumed a true comparison month by month is afforded. If any one month's cost seems excessive, it is possible to determine

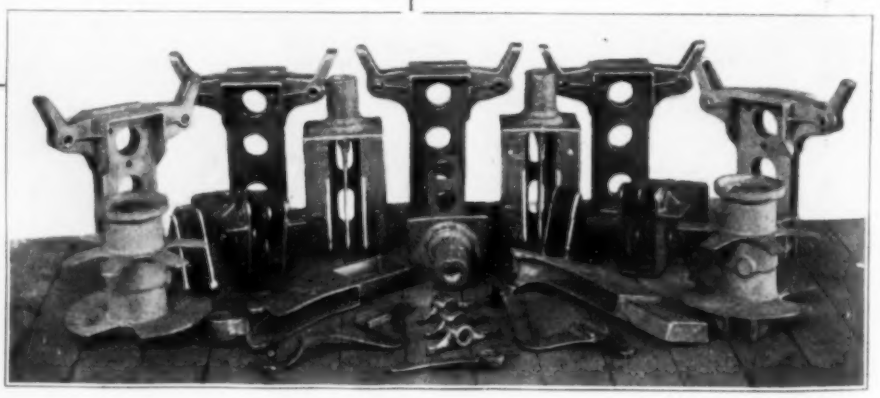
NUGENT STEEL CASTINGS CO.

Production Costs - JAN 1924

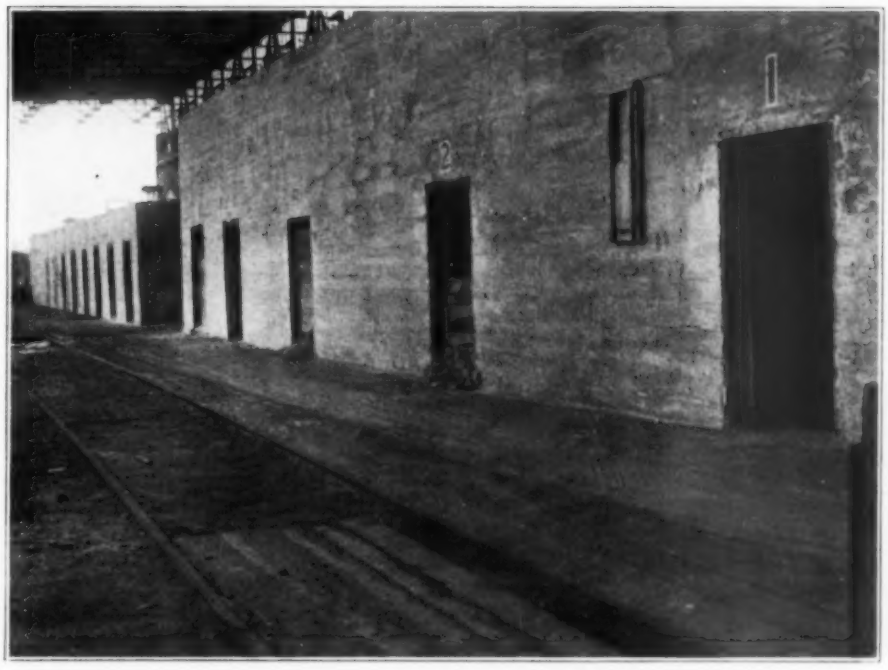
Heated Metals	Material Amount	Material Per Ton	Labor Amount	Labor Per Ton	Total Amount	Total Per Ton
10% Silicon	2618	06			2618	06
Bundle Stock	189996	4.77			189996	4.77
Foundry Sand	27654	713			27654	713
Plate Scrap	666478	1436			666478	1436
Turnings Scrap	479504	1236			479504	1236
Shop Scrap	163344	340			163344	340
80% Manganese	17736	457			17736	457
50% Silicon	1361	30			1361	30
Aluminum	1918	46			1918	46
Ferro Carbon	9655	25			9655	25
Clay	2708	06			2708	06
Electrodes	19498	497			19498	497
Gas	870	02			870	02
Fuel Oil	26000	67			26000	67
Gasoline	6940	178			6940	178
Electric Power	69746	1794			69746	1794
Heated Material	69390	1784			69390	1784
Sand	2460	06			2460	06
Miscellaneous Supplies	2396	62			2396	62
Chemists & Laboratory Labor			7744	172	7744	172
Crane & Transportation Labor			1648	36	1648	36
General Furnace & Supervision Labor			33894	747	33894	747
Ladles & Pots Labor			2818	62	2818	62
Heated Metal & Ends Labor			6608	144	6608	144
Scrap Proceeds Credit	1620	180			1620	180
Total Foundry Costs	2694	6660	51134	1136	33816	7796
Heated Depreciation						
Silica Flour	817	18			817	18
Bench Clay	2680	196			2680	196
Bench Brick	248	55			248	55
Clay	2814	62			2814	62
Refining & Grinding	400	10			400	10
Direct Labor			1078	2438	1078	2438
Indirect Labor			468	2106	468	2106
Heated Labor			1198	266	1198	266
Crane & Transportation Labor			1419	316	1419	316
Nails	261	58			261	58
Heated Material	1407	312			1407	312
Sand	1611	358			1611	358
Other Supplies	234	526			234	526
Total	5678	1260	2308	5126	8736	1938
Finish & Pattern Labor			810	180	810	180
Finish & Pattern Material	1360	446			1360	446
Total	1360	446	810	180	2170	626
Total Heating Costs	7038	1706	3119	5306	10157	2564
Equipment Depreciation						
Retorts	3964	88			3964	88
Oxygen	7590	168			7590	168
Coal	240	06			240	06
Labor General			1133	2496	1133	2496
Heated Labor			78	218	78	218
Sand	4898	108			4898	108
Other Supplies	3070	68			3070	68
Emery Wheels	1069	246			1069	246
Rubber Wheels	696	176			696	176
Tumbling Material	240	54			240	54
Welding Labor			516	118	516	118
" Mats	3644	80			3644	80
Annealing Gas	39	08			39	08
" Oil	1518	336			1518	336
" Labor			666	148	666	148
" Repairs	716	158			716	158
Total Finishing Costs	6491	1429	1334	2970	19826	4400
Core Department						
Clay Compound	308	08			308	08
Commercial Oil	947	212			947	212
Gas	1362	304			1362	304
Labor Direct			3774	838	3774	838
Labor Indirect			2004	444	2004	444
Repairs Labor			49	11	49	11
Heated Material	400	08			400	08
Sand	4988	110			4988	110
Other Supplies	778	18			778	18
Wire Ends	246	54			246	54
Total Core Cost	3011	712	5827	1302	9109	2014
Carried Forward To Shipping, Inspection, Heated Cleaning & Administration	45396	10058	45298	10070	93694	20978



AT THE LEFT—TABULATION OF ALL COSTS PERMITS DISTRIBUTION OF EACH ITEM TO ITS PROPER SOURCE—ABOVE—AVERAGE RESULTS SHOW A PROPORTIONATE LOW OVERHEAD PERCENTAGE—BELOW—THE COMPANY SPECIALIZES IN THIN SECTION CASTINGS DESIGNED TO MEET QUALITY REQUIREMENTS



not only in what department the increase has occurred, but also whether a labor or a material item, and what operation or commodity was responsible. Foremen look forward with interest to the monthly cost sheets handed them and a spirit of economy is furthered. These de-

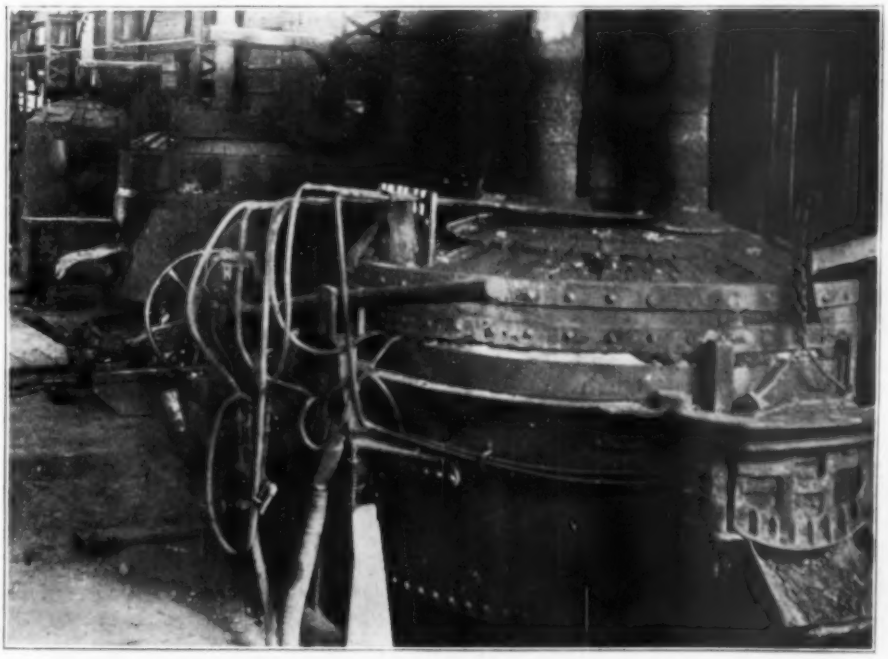


AT THE RIGHT—INCOMING MATERIALS ARE STORED IN BINS AT THE SIDE OF THE UNLOADING TRACK AND BENEATH AN OVERHEAD CRANE

tailed departmental cost sheets are available not later than the eighth of the following month, or in ample time to apply remedies for any items of cost that appear out of line.

In addtion to the departmental cost,

which serves as a stimulus to operating efficiency and which must necessarily show an average cost on the entire tonnage produced during the month, specific costs are kept on individual jobs or patterns whenever they run into produc-



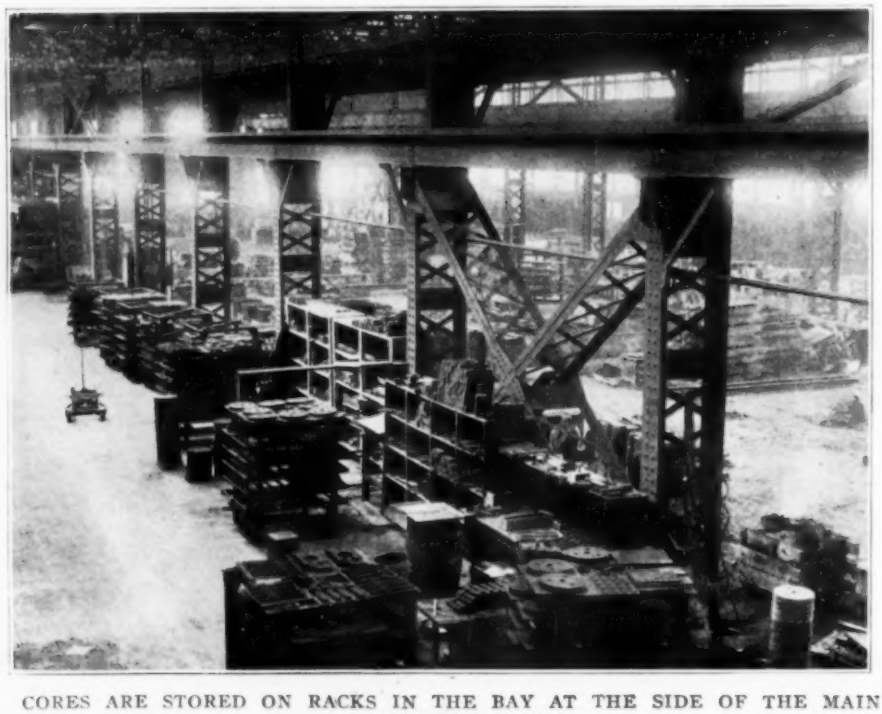
ABOVE—CONSIDERABLE SPACE IS DEVOTED TO THE CLEANING, ANNEALING AND INSPECTION DEPARTMENT—AT THE RIGHT—THREE ELECTRIC FURNACES PROVIDE AMPLE MELTING CAPACITY

tion quantities. Since this is strictly a jobbing foundry, any job which will insure a molder a full days' work is considered a production run from the specific-cost standpoint. Such castings are weighed with the heads and gates on

EXTENSIVE CORE OVEN FACILITIES ARE REQUIRED TO MEET THE NEEDS OF THE LIGHT CASTING DEPARTMENT

them to determine the yield and establish the metal cost. All of the molding labor and most of the core and cleaning labor is on the piecework basis, so there is no guess work as to the total direct labor. Record is kept of the defectives because of their effect on the ultimate metal and direct labor figures, and overheads are applied as a percentage on the known factors mentioned. Thus overhead expense is distributed to the individual job in proportion to the direct labor expended and the customer who has a fast-moving job on which the direct labor is below the average is only taxed with his proportion of the overhead.

The individual carload scrap bins are located just outside the furnace or south end of the main building. The incoming railroad track, which handles only incoming raw materials, continues parallel to the main building. Between the track and the main building and just outside of the latter are concrete bins providing storage for sand, electrodes, manganese, silicon, ganister, clay, brick, emery wheels and similar raw materials. These bins are under cover and are served by a 7½-ton crane made by The Whiting Corp., Harvey, Ill. Access is had to the main building at the furnace end, the extreme north end and midway. Metal from the scrap bins is loaded into chutes and transported by an overhead system, installed by Louden Machinery Co., Fairfield, Ia., to the scales just outside the furnace end of the main building. The metal is charged in the electric furnace, of which there are three, from the chutes. The furnace equipment includes one 3-ton furnace built by the Pittsburgh Furnace Co., Milwaukee, and two furnaces—one 3-ton and one 1-ton—manufactured by the Industrial Furnace Co., Chicago, now the Repel-Arc Furnace Co., Indianapolis.



CORES ARE STORED ON RACKS IN THE BAY AT THE SIDE OF THE MAIN FOUNDRY FLOOR

Molds for the larger work are made in the main bay of the foundry building and are placed upon racks as molded. The equipment of the main building includes one 10-ton and one 5-ton crane erected by Pawling & Harnischfeger, Milwaukee. Small snap-flask work is done in the side bay on the west side of the main building. The floor of this side bay is of concrete. The main foundry building is brick, with a roof of the Pond truss type. One sand mixer handles all molding sand and another machine of the same type all backing sand. These machines were manufactured by the National Engineering Co., Chicago. Every particle of backing or heap sand is prepared in a mill and delivered to the molders by grab buckets and storage battery trucks. This practice as contrasted with the usual method of cutting over the heap sand on the floor has, by making it possible to control moisture, brought about improvements in the quality and appearance of the castings. It has reduced losses chargeable to poorly-mixed sand, and at the same time has effected economies in the preparation of the sand.

How Cores Are Handled

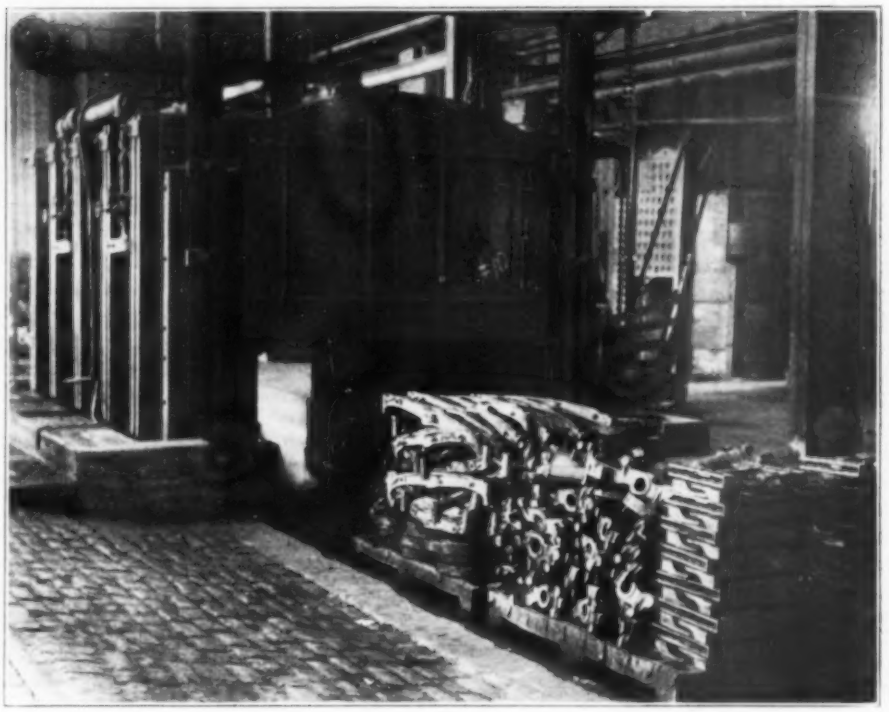
The coreroom is ranged along the east side of the main foundry building, corresponding to the side bay for snap work on the west side. All cores are made at the south end of the coreroom on benches provided with hoppers which makes possible the delivery of core sand to the benches by an overhead monorail and dump bucket without interference with the coremakers. The core ovens are located at the north end of the coreroom. Core racks are standard, enabling any rack to go into any oven. Racks are placed alongside the core makers and when filled are pushed to the ovens by means of lift platform trucks. Core makers never carry their cores to the ovens, hand lift trucks being employed exclusively. From the time they leave the core box until they are delivered to the molder they are never handled. Gas and electricity are employed in these ovens for drying cores. These ovens were built by the Ohio Body and Blower Co., Cleveland and the National Machine Co., Chicago. All core sand is mixed in a mill separate from that used for facing but of the same type. This

averts any conflict over the use of the mixers.

Practically all of the work at the Nugent foundry is made in green sand. Gas mold driers are employed for pressure fittings, gear blanks, die blocks and similar work requiring dry sand. These permit the molds to be dried on the floors where made. A mold made in a wooden flask and dried by this gas burner is a thorough and complete job. Nothing but hot air reaches the surface, hence there is no burning of the mold surface. Since the heat is applied to the surface of the mold and not from the outside, the tendency is to drive the moisture out of the sand, so that should a mold not be dried thoroughly throughout, that part coming in contact with the metal is certain to be freed from moisture.

The entire heat of any furnace is poured into a 4-ton ladle and removed to a ladle stand in the center of the molding department. Large castings in the main bay are poured from a 1000-pound crane ladle, while the small work in the side bay is poured from shanks. Molds for the larger work in the main bay having been placed on racks as molded, are poured on these racks; and after pouring the racks are removed by cranes and carried to the shakeout at the extreme north end of the molding floor. These racks are employed to bring the empty flasks and bottom boards back to the molding floor. This practice of pouring on racks also insures that all sand is delivered to the shakeout floor on close to the sand mills. The smaller castings in the side bay are shaken out there, and the sand is loaded in boxes on skids, while the castings are loaded on other skids. Storage battery trucks made by Elwell-Parker Electric Co., Cleveland and Automatic Transportation Co., Buffalo, convey the skids with the castings to the cleaning room and the

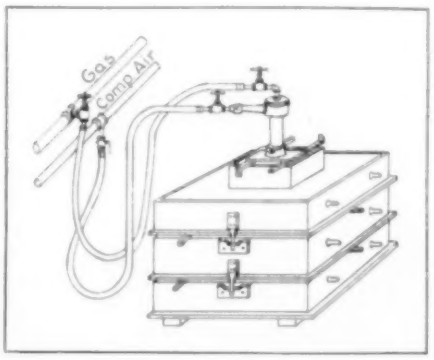
CORE SAND, FACING AND BACKING SAND ALIKE ARE PREPARED IN MULLER TYPE MIXERS



ALL CASTINGS ARE ANNEALED UNLESS THE CUSTOMER PARTICULARLY REQUESTS THAT THEY SHALL NOT BE HEAT TREATED

sand to the sand mills. All old sand is carried to the sand mills and reconditioned.

The cleaning and shipping departments are located at right angles to the main foundry floor and the entrance to the cleaning department is at the shakeout. The larger castings which have been shaken out at the entrance to this east and west building are picked up by a crane and loaded on racks. If the heads and gates can be removed by a sledge this is done following the shakeout and the castings then are taken to the sand blast. Castings whose heads must be cut off or burned off are sandblasted first and then go to the oxy-acetylene torches, where equipment made by the Air Reduction Sales Co., New York, is utilized.



SPECIAL TYPE GAS FIRED MOLD DRYER IS USED TO SKIN-DRY MANY OF THE LARGER MOLDS

The small castings from the side bay, which have been loaded on skids, are delivered directly to the sprue cutter where the gates are removed. They then are taken to the sand blast. In every instance, sand blast is employed as early as possible in the cleaning operation to enable inspectors to search out defects. These are repaired or defective castings scrapped before further effort is expended upon them. The sand blast equipment comprises one unit each from the plants of the W. W. Sly Mfg. Co. Cleveland, and the Pangborn Corp., Hagerstown, Md.

Castings with surface defects which can be remedied by welding go to the welder direct from the sand blast. Before a casting is welded, the part to be repaired is chipped out to clean metal. This enables the inspector to judge the extent of the defect and guides him in determining whether the casting should be repaired or scrapped, and if the former, it insures a dependable weld being made. While practically all of the welding done at the plant is to rectify slight surface blemishes, so careful is the company to preserve the quality of welds made that the welding operator is one of the few men in the plant not compensated on a piecework or tonnage basis. Every casting is taken either from the sand blast or the welder to the grinders—heavy castings to the swing grinders and light ones to the stand grinders. After grinding, all castings again are inspected, primarily to see whether the heads and gates have been removed flush with the casting and also to scrutinize for defects which may have escaped the first inspection. Castings then are removed to the chippers where fins or rough edges are attacked with pneumatic chip hammers. Once more

the castings are inspected to check up on the chipping and to make certain that all holes have been drifted. A 5-ton crane made by the Milwaukee Crane and Engineering Co., Inc., Milwaukee, serves the cleaning department.

Next the castings are piled on annealing racks, which are picked up by the crane and placed on annealing oven trucks. No casting is shipped from the plant without having been annealed, unless the customer states specifically that certain parts are wanted in a raw or unannealed state. The double-end annealing oven is oil-fired and equipped with recording pyrometers. From the annealing oven the castings are taken to the tumbling mills, or in the case of those which cannot stand this process, to the sand blast. From the tumbling mills or the sand blast the castings are conveyed on skids to the final inspection floor, where every casting is inspected and a large percentage gaged to insure the right dimensions. Both of these features are requirments included in inspection standards adopted by the Electric Steel Founders' Research group, of which the Nugent company is a member. If final inspection reveals that any castings are distorted they are conveyed to a 50-ton press for straightening.

A depressed track permits castings to be loaded into freight cars at the east end of the cleaning room. This track is wholly apart from that giving ingress to raw materials. Provsion also is made for loading castings upon motor trucks within the building itself.

The company specializes on reasonably thin castings. Since steel melted electrically is hotter than that produced by other processes, it lends itself to lighter sections. This permits a sizeable reduction in weight without any loss of strength. The Nugent company employs 225 men and on the basis of castings averaging from 15 to 20 pounds each its normal output is 450 tons monthly. A concrete and brick, pattern storage building now nearing completion will provide over 100,000 cubic feet for this purpose. The company was organized in 1916 as the Electric Steel Co., and operated under this name until the spring of 1923, when it was changed to the Nugent Steel Castings Co. Officers of the company are: President, Charles Piez; vice president and general manager, William J. Nugent; treasurer Prentiss L. Coonley; and secretary, C. A. MacDonald.

Discuss Oxygenated Air in Metallurgy

GREAT consideration was given to problems of the iron and steel industry at the convention of the American Institute of Mining and Metallurgical Engineers held in New York, Feb. 18-21. Discussion ranged from the practical, everyday questions of blast furnace and open-hearth practice to conceptions of how the use of oxygen or oxygenated air will affect the design of equipment for metallurgical processes. Methods of testing steel, factors governing the life of refractories and many other subjects were given attention in the four-day session devoted to iron and steel.

No one subject attracted more attention at the annual meeting than oxygenated air, the metallurgical applications of which were discussed Wednesday afternoon. Dr. Bradley Stoughton, Lehigh university, Bethlehem, Pa. presided.

The subject was introduced in four papers, the most comprehensive of which was "Use of Oxygen or Oxygenated Air in Metallurgical and Allied Processes," by F. W. Davis, United States bureau of mines. "Enriched Air in Metallurgy" by W. S. Landis, vice president, American Cyanamid Co., New York; "Cheap Oxygen in Metallurgy," by Edmund B. Kirby; and "Effect of Oxygen-Enriched Air in Roasting of Zinc Ores" by B. M. O'Hara, United States bureau of mines, Rolla, Mo., and co-authors with the Missouri School of Mines and Metallurgy, also were presented.

Mr. Kirby stated that the use of oxygen could be effected in the copper and lead industries without much change in equipment. In the iron and steel industry, however, some equipment would have to be scrapped, new designs worked out and new capital supplied. He predicted that the iron and steel industry will take the forms of furnaces worked out for the copper industry.

R. H. Sweetser declared there is no doubt but what enriched air would speed up operation of the blast furnace. Great changes in design would be required and he said he would not be surprised if the rectangular-shaped copper blast furnace would be adopted if oxygen were used extensively. The great speed of reduction would necessitate rapid charging to keep the furnace filled and to control the temperature. He recalled a meeting in Cleveland in 1912, when a group of blast furnace men, including the late James Gayley, listened to a discussion on blast furnace slags by operators of copper blast furnaces. He predicted iron blast furnace men again will turn to the copper men.

Waldemar Dyrssen, New York, explained that rectangular blast furnaces for ironmaking are not new, he having witnessed many in operation in Russia 15 years ago.

B. E. Field, Union Carbide & Carbon Co., Long Island City, presented arguments to support his contention that no great savings would be effected by oxygen in the blast furnace. T. L. Joseph described a new experimental blast furnace under construction at Minneapolis and suggested that an investigation of the use of oxygen in the blast be conducted on this small furnace before tests on a standard stack are undertaken. Arthur G. McKee, discussed Mr. Davis' paper at length, referring to the excellent work of Sir Lowthian Bell, J. H. Johnston Jr. and others in working out blast furnace problems. He touched on the ratio of carbon dioxide to carbon monoxide and suggested the advisability of injecting a powdered fuel at the tuyeres be investigated.

Charles Hart, Delaware River Steel Co., Chester, Pa., declared he does not think the use of oxygen would radically change blast furnace design. He outlined some features in the operation of Swedish electric blast furnaces, showing the low consumption of charcoal.

Sidney Cornell, New York, quoted figures to show that in open-hearth practice the operating cycle might be reduced from 10 to 6 hours by using oxygen. He said the oxygen open-hearth might be round instead of rectangular as at present. Mr. Cornell declared oxygen cannot be made for $3 per ton.

Waldemar Dyrssen explained the probable effect of using oxygen in gas producers, exhibiting heat balances.

In conclusion, after more than a score had discussed the problem, R. B. Moore explained that the $3 per ton for oxygen is an arbitrary figure and that it has been introduced mainly to enable discussion to be based on the assumption that oxygen for blast furnace use would be commercially available. However, he referred to a prediction made in 1916 by a leading authority that oxygen would be produced in large quantities for $2.62 per ton.

On a motion by Mr. Sweetser it was voted to recommend that experimental work with oxygenated air be conducted on the small furnace being built by the United States bureau of mines.

R. D. Spradling, who has been located at the Baltimore office of the Blaw-Knox Co. has been made district manager of the standard building department at Chicago.

Hunting Ills With the X-ray

Diagnosis of Castings Defects Made Possible by New Application of Roentgen Rays—Position and Character of Cavities Indicate Remedies To Adopt in Each Case

BY V. E. HILLMAN

THE X-ray in commerce manufacturing, and surgery is used for a multiplicity of purposes. Its development dates from November, 1895, when Prof W. C. Roentgen communicated his discovery to the Physico-Medical Society of Wurtzburg, Bavaria. He explained that when a current of electricity is passed through a glass tube, containing a gas at low pressure, invisible light waves are given off. This source of radiation, hitherto unknown, has contributed to the sum total of human knowledge. The X-ray has enabled man to see into and through opaque objects. A few examples will suffice to illustrate its practical application.

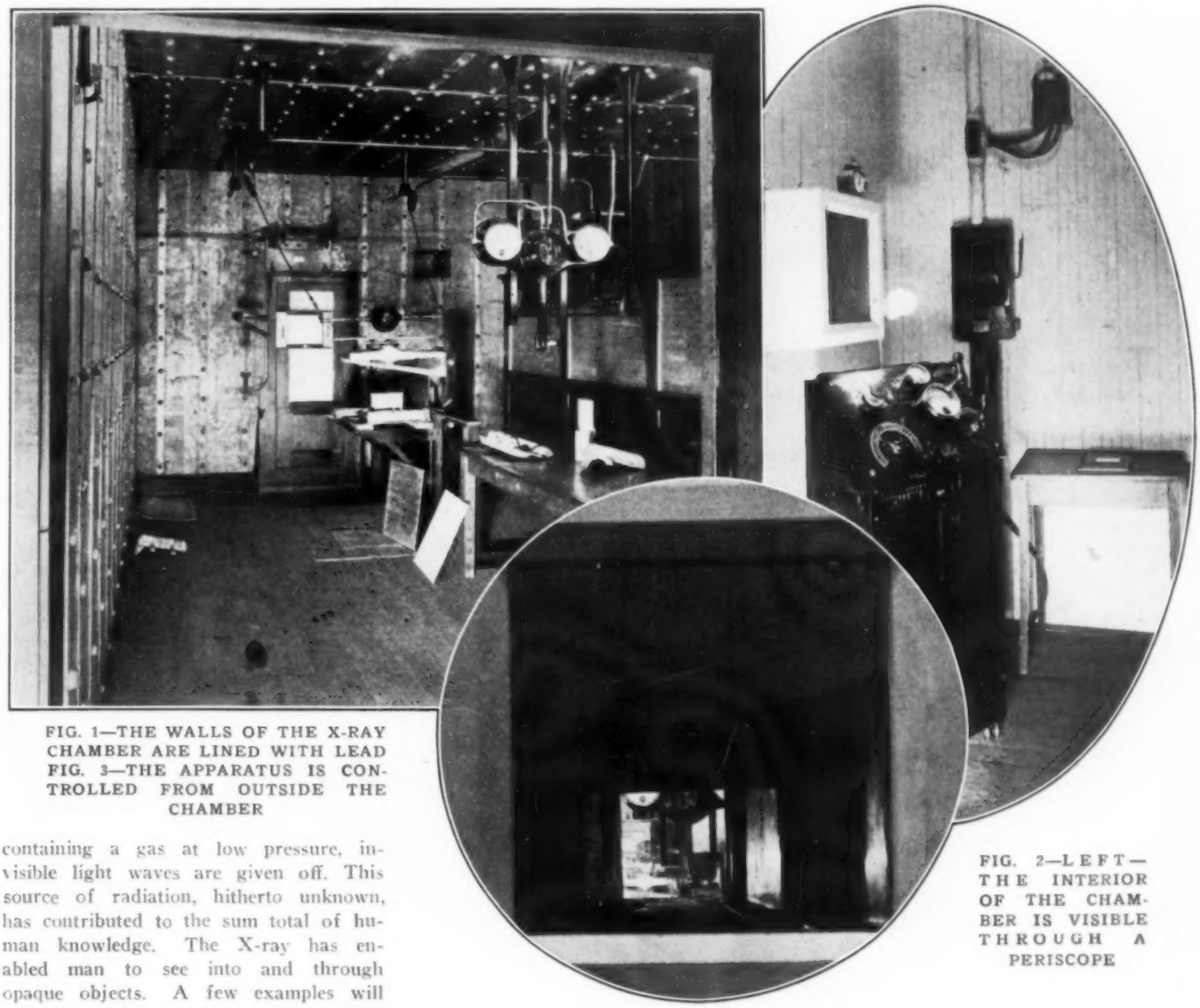


FIG. 1—THE WALLS OF THE X-RAY CHAMBER ARE LINED WITH LEAD
FIG. 3—THE APPARATUS IS CONTROLLED FROM OUTSIDE THE CHAMBER

FIG. 2—LEFT—THE INTERIOR OF THE CHAMBER IS VISIBLE THROUGH A PERISCOPE

Three kinds of imitation diamonds are found on the market. These are quartz, artificial sapphire, and rhinestone. Investigation discloses that a genuine diamond offers little or no resistance to the passage of X-rays. Hence, if the four stones are placed between the vacuum tube and a sensitized screen, shadows will be cast upon the latter. Their transparency to X-rays is indicated by their respective shadows. The outline of the diamond is barely visible. The quartz shadow is a trifle darker. The sapphire image is a deeper shade, while the rhinestone presents a distinct silhouette. Therefore, the X-ray is of practical value to the jeweler and diamond merchant.

Occasionally, an after-dinner cigar does not *pull* properly. Minute holes through the side of the cigar specify its draft, so that it does not *draw* properly. These imperfections are occasioned by the larvae of the *cigarette beetle*. Research has proved that X-rays are sufficiently powerful to destroy the eggs of the insect The cigars, after having been packed in boxes, are X-rayed. The expense involved is offset by the decrease in defective cigars. Consequently, the cigar manufacturer has found that the X-ray apparatus is a valuable adjunct for bettering his product.

The value of the X-ray in surgery

The author, V. E. Hillman, is director of research for Crompton & Knowles Loom Works, Worcester, Mass.

needs little or no comment. It is a distinct aid to the surgeon who attempts to set a broken bone. Its utility in detecting tuberculosis of the lungs is being studied. The X-ray is invaluable in proving the presence of gall stones. Again, ulcers of the stomach readily may be brought to light by X-ray analysis. Moreover, an X-ray picture will determine the exact location of a stone in the kidney In short, radiographs have revealed untold wonders to the physician.

By the same token, metallurgists have been equally diligent in taking advantage of the opportunities offered. The procedure that is followed for finding hidden defects in castings, is similar to that used by the surgeon in examining the human body, except that rays of maximum penetrating power are required.

X-rays have been employed in the study of copper metallurgy. Dr. Weintraub of the research laboratory, General Electric Co., discovered that the addition of boron suboxide to molten copper would produce metal of extreme soundness, free from blowholes and porosity. Pure copper cast in the ordinary way, is porous, whereas metal poured with the aid of the boron scavenger is remarkably sound. Radiographs of treated and untreated copper castings portray a distinct difference in structure.

Moreover, blowholes, porosity, and shrinkage flaws are a source of constant annoyance to every iron and steel foundry. The conditions which give rise to their formation may be studied accurately by radiographs. The use of the X-ray affords the foundryman an efficient and up-to-date means of visualizing the interior of his product, thereby producing castings of maximum soundness. The shortcomings of current practice are found quickly, and the effect of improvements readily may be noted. The scheme bids fair to be eminently successful for jobbing foundries which are unfamiliar with certain classes of work. A pilot casting may be made and examined. The information thus acquired will enable the foundryman to anticipate and provide against undue losses. Moreover, the malleable iron foundry whose ingenuity is taxed to the utmost to produce sound work from the numerous intricate patterns involved will gain much knowledge by an intelligent study of radiographs.

It is not to be understood that X-ray analyses are advocated as a means of inspection. The cost would be prohibitive. Where the cost of machining is expensive, or where human safety is dependent upon the casting, radiographic inspection may be justified. However, radiographs will enable the foundryman to study the efficacy of risers, the location of blowholes, and the deleterious influence of extremely moist sand. By an intelligent correlation of these data, ways and means may be devised for eliminating the difficulty.

An X-ray examination will reveal the molding advantages of different gating methods. A survey of the porous areas will offer suggestions for locating the gates at the right place on the pattern, and for making them the proper size. Radiographs are a distinct aid in studying contraction and internal shrinkage. They turn on the light of physical science, and eliminate much of the cut and dry method now employed.

The study of the general principles underlying the formation of blowholes rapidly is approaching an exact science. For instance, the shape of the cavities is an aid in determining the history of their development. Pure gas pockets, free from slag, tend to be spherical, whereas, elongated areas in the radiographs generally are an indication that gas is either entering or escaping from the metal. However, it is difficult to distinguish between slag inclusions and an ordinary cavity.

Three types of cavities have been studied. Their characteristics are brought to light by dissecting the casting in accordance with their location on the radiograph.

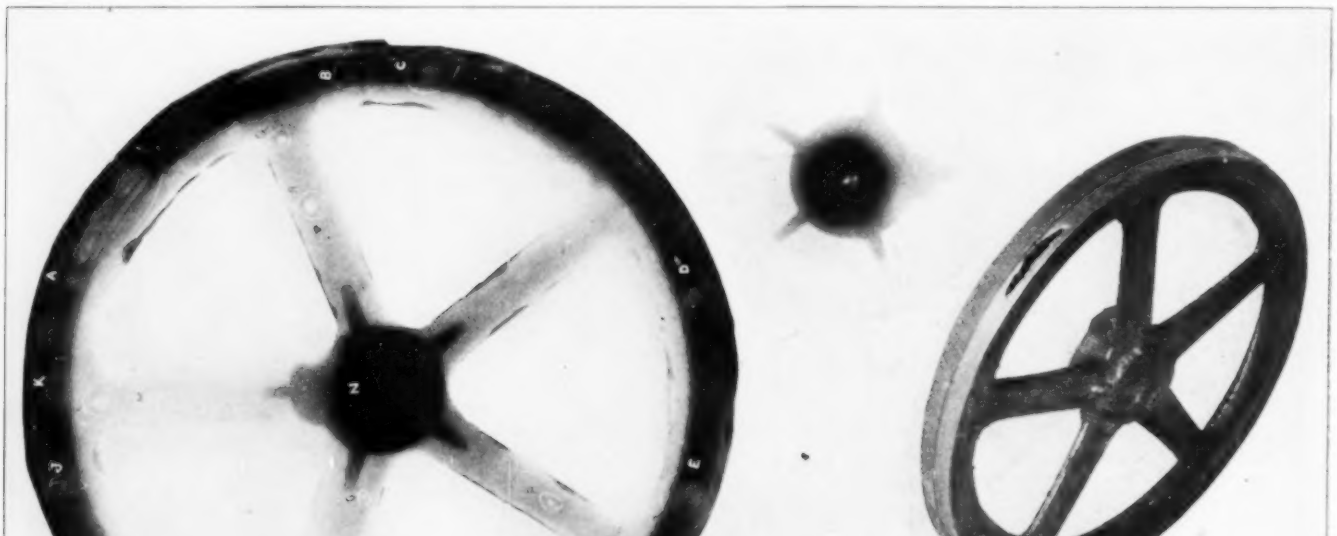


FIG. 4—THE RADIOGRAPH INDICATES SUB-SURFACE DEFECTS IN A GEAR BLANK FIG. 5—INSET—SHRINKAGE CAVITY DRIVEN TO THE HUB CENTER FIG. 6—DISSECTED CASTING CHECKS THE X-RAY DIAGNOSIS

A type of blowhole frequently encountered possesses a blue oxide film. It may be designated conveniently as an oxide blowhole. Its formation is occasioned by the decomposition of steam, which gives rise to its constituent elements, hydrogen and oxygen. The oxygen produces the blue surface that is common to this kind of void. Dry air entrapped in the mold also may have a contributing influence. An oxidizing gas dissolved in the metal will act likewise. Steel foundries are cognizant of the fact that these pockets are due to green sand and improperly dried molds. They may be avoided by baking the molds thoroughly, especially on the surface. In gray iron practice, they have been eliminated in a large measure by properly tempering the sand and the judicious use of the swab.

The second kind of pocket common to ferrous castings may be termed a bright blowhole. It has a shiny surface. Its appearance is due to the reducing action of carbon monoxide. A fine powder found in this type of cavity contained

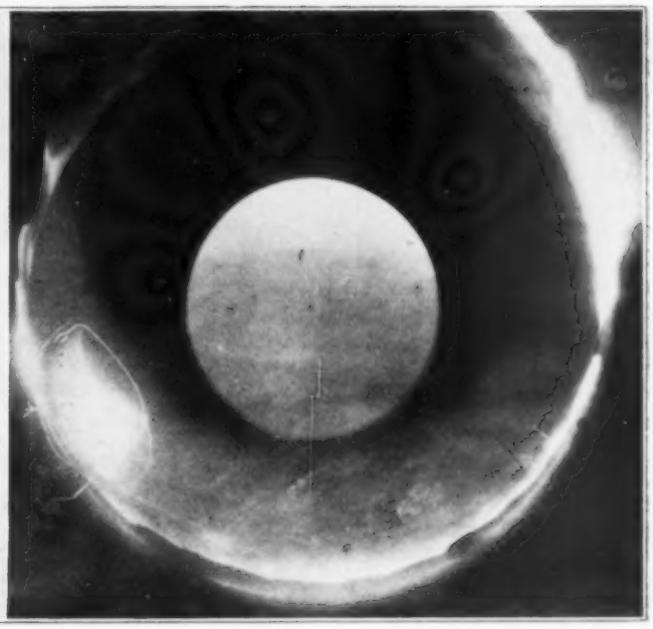


FIG. 7—A CAST IRON GEAR BLANK INVESTIGATED FOR DEFECTS FIG. 8—IMPROPER VENTING CAUSED A CAVITY IN THE FLANGE

carbon and silicon. Hence, it is reasonable to assume that the pocket was caused by the *washing* of the sand and the facing compound. A slight washing of the core also may contribute to the presence of this residue which is nothing more or less than a combination of silica and organic matter. Defects of this nature may be overcome by using sand of high refractory properties, containing the proper percentage of bond. Furthermore, it is advisable to use a highly tenacious facing compound which will adhere to the surface of the mold, thereby withstanding the cutting action of the flowing metal.

The third class of cavities possesses a rough surface. These may be referred to as natural shrinkage areas. It is difficult to overcome them. At best, in the majority of cases, it is possible only to dispatch them to the center or neutral axis, where their presence is less harmful. Cavities which come under this particular classification sometimes can be avoided by changing the design of the pattern; namely, the elimination of adjacent thin and thick sections, and the intelligent employment of chills and well-proportioned risers. Radiographs have definitely proved, especially in the steel foundry, that the hydrostatic pressure contributed by the riser affects the solidity of the casting only to a small depth. Hence, it has been shown to be advisable to use more and smaller risers. The bulk of the metal in a large riser does not feed. A radiograph will detect a series of cavities under the riser. This indicates to what extent the hydrostatic pressure has been effective.

The employment of the X-ray in gray iron foundries is in its infancy. Considerable data are being accumulated. No doubt, additional information will be forthcoming. The chief purpose is to show the molder where the defect lies, and the causes thereof.

The apparatus required is somewhat complicated. The work is performed in a chamber 18 x 18 x 10 feet, which contains a transformer, a rectifier, a specialty designed Coolidge tube, and a stand on castors, which accommodates the parts that are to be radiographed.

The life of the X-ray tube is 75 hours. The cost is in the neighborhood of $150. The complete outfit costs in the vicinity of $12,000, although the author understands that the various manufacturers of X-ray apparatus have been in conference to determine the feasibility of placing less expensive apparatus on the market.

Fig. 1 illustrates the appearance of the X-ray chamber. The walls of the room are covered with ¼-inch lead surfacing. A lead-walled room is necessary inasmuch as it prevents secondary radiation, which has a tendency to fog the film. Note the Coolidge tube in the center. The part to be radiographed is placed under this in combination with suitable photographic plates and a fluor-

FIG. 9—SPONGY SECTION IS INDICATED AT THE LOWER RIGHT FIG. 10—NO DEFECTS WERE OBSERVED IN THIS SECTION FIG. 11—SPONGY METAL IS INDICATED BY THE PORTION RESEMBLING A MACKEREL SKY

escent screen. The latter is used to intensify the direct effect of the rays. The rays then are directed through the object for the requisite period. The film is developed, and the negative studied. It is advisable to examine the negative instead of the print. The defective areas depicted on the former manifest a clearer outline. Much of the finer detail is lost in the print. That is to say, the outlines are blurred and indefinite.

Adjacent to the lead chamber is a small room equipped with a switchboard and a periscope arrangement with lead glass reflectors and a window en-

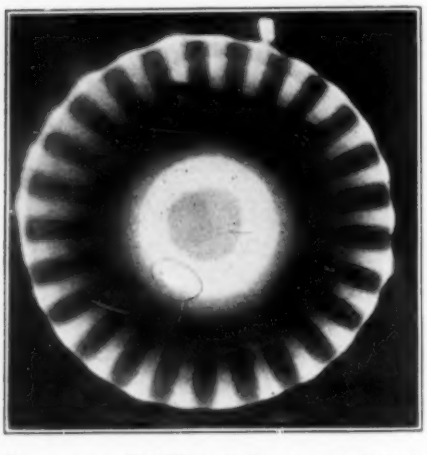


FIG. 12—A HIDDEN FLAW IS INDICATED IN THE CAST IRON BEVEL GEAR

abling the operator to view the interior of the room while the casting is being radiographed.

Fig. 3 shows the control board and periscope window, which enables observation to be made. It is essential to protect the operator from the powerful rays that are used.

Fig. 2 illustrates the interior of the lead chamber as seen with the aid of the periscope.

A high potential is essential—namely 200,000 volts, direct current. This is derived from an alternating current of 240 volts. A current of this intensity is necessary to procure a penetration of approximately 4 inches. The time of radiographic exposure is a function of the cross section of the casting. Five to ten minutes will suffice for sections 1 inch thick or less. Heavier sections, that is 3 to 4 inches, require from ½ to 1½ hours.

Occasionally, castings are marked off into several sections. Hence, three or four radiographs are required. This sometimes is necessary when the interior of the entire casting is to be explored.

Fig. 4 is a radiograph of a steel gear blank. Area *A* is a steam pocket. It comes under the classification of an oxide blowhole. Area *L* is a natural shrinkage cavity and may be listed under the third classification of blowholes. The other cavities, namely *B, C, D, E,* etc., are for the most part blowholes of the first denomination, caused by entrapped air or steam.

Fig. 5 illustrates a natural shrinkage cavity or pipe which has been dispatched to the center or neutral axis of the hub where it will be removed when the hole is drilled.

Fig. 6 shows the casting after it had been dissected. The blowhole revealed by the radiograph in Fig. 4, area *A*, is plainly discernible. The procedure of radiographing the casting and then dissecting it is followed merely for research purposes. After working data are accumulated, radiography in itself will be sufficient.

Fig. 7 is a photograph of a cast iron blank that is used for chilling metal. It is cast on the side. Its interior has been explored by a series of radiographs shown in Figs. 8, 9, 10 and 11.

Fig. 8 portrays a cavity in the flange. Improper venting is evidently responsible for the defect. However, nothing definite has been proved.

Fig. 9 represents a section taken through the center of the casting between the flanges. The arrow mark is of no significance. It is a lead indicator which is used in locating the manner in which the picture was taken. In the lower portion of the print, spongy metal is readily detected. The cavity in the center of the picture is a surface pit which was visible when the casting was radiographed.

Fig. 10 is reproduced from a film which was exposed to rays traveling through the center of the casting between the two flanges. No defects are in evidence. It is interesting to observe that the numbers are distinctly portrayed in the radiograph.

Fig. 11 shows a radiograph taken in the same manner as Figs. 9 and 10. An area of spongy metal may be noted. In the negative, this area suggests the appearance of a mackerel sky. The black spots are occasioned by a defect in the film. Only the white spots indicate cavities.

Fig. 12 is a radiograph of a cast iron bevel gear. A hidden flaw was detected in the interior. Unfortunately, the print does not reveal the cavity as well as the negative. The picture is of interest inasmuch as it portrays the effectiveness of X-ray analysis. The bevel gear is shown in Fig. 13.

This article has been written to arouse interest in the fascinating subject of X-ray analysis. The author is free to admit that the entire project is in its infancy, and the primary purpose of presenting the subject is to stimulate further endeavor on the part of gray iron foundries.

The author desires to acknowledge his indebtedness to Dr. H. H. Lester of the Watertown Arsenal, Watertown, Mass., for some of the illustrations, and for the valuable aid and information offered in the experimental work that has been conducted in this laboratory.

Offers Fellowships

The college of mines of the University of Washington is offering five fellowships for research in metallurgy, mining and ceramics in co-operative work with the bureau of mines. The fellowships are open to graduates of universities and technical schools who are

FIG. 13—BULKY BEVEL GEAR EXPLORED AS SHOWN IN FIG. 12

properly qualified to undertake research investigations. The value of a fellowship is $810 per year of 12 months, beginning July 1. Fellowship holders become candidate for the degree of master of science in mining engineering, or in metallurgy or in ceramics, unless an equivalent degree previously has been earned. The purpose of these fellowships is to undertake the solution of various problems being studied by the bureau of mines that are of especial interest to the state of Washington and the Pacific Northwest. The following subjects have been selected for the year 1924-25: Beneficiation of coal especially coal washing; electrometallurgy, iron and steel problems, super-refractories; ceramics, super-refractories, whiteware bodies, and other problems. Applications should be addressed to Dean Milnor Roberts, College of Mines, University of Washington, Seattle.

Foundrymen To Meet

The annual meeting of the Institute of British Foundrymen will be held at Newcastle-on-Type, England, June 4-6. A number of papers will be read and discussed and visits will be arranged to prominent foundries in the vicinity where special facilities are available for studying the manufacture of castings for marine engines and ships. R. O. Patterson, Smith Patterson & Co., Blaydon-on-Tyne, president-elect, will occupy the chair.

Trains Own Staff of Molders

Necessity for Recruiting the Ranks of Semiskilled Molders Has Lead One Firm To Adopt an Intensive Course of Instruction That Has Produced Satisfactory Results

EVEN a casual survey of the casting field, particularly over the literature devoted to the field for the limited period of 1923, indicates that the subject of training foundry workers is paramount in importance. At the Cleveland convention of the American Foundrymen's association April 28-May 3, 1923, a symposium of papers was presented on the subject and precipitated one of the most interesting discussions of the entire series of sessions. The collected papers were presented in the June 1, 1923, issue of THE FOUNDRY and also are included in the published *Transactions* of the association. A paper prepared by H. A. Frommelt, superintendent of apprentice training for the Falk Corp., Milwaukee, and read before several foundrymen's associations, also was published in THE FOUNDRY in two installments Sept. 1 and Sept. 15.

A comprehensive treatise on the subject, a treatise that embraces apprentice training in all sections of the industrial field, has been issued as bulletin 87 trade and industrial series 25 by the federal board for vocational training, Washington. It is entitled "Apprentice Education" and is a survey of part time education and other forms of extension training in their relation to apprenticeship in the United States. The bulletin primarily is intended to serve as an encyclopedia of information for those interested in apprentice training who seek specific data on developments in the United States in the field of apprentice education. It is not a comprehensive study of all forms of apprenticeship in the United States, but rather is a study of the existing and possible relations between apprenticeship and the public school system.

WHEN A CANDIDATE APPROACHES HE

Training foundry operators once more is looming large among the major problems which confront the manager or owner of a casting plant. During the war period when production sky-rocketed at a pace and to a point never anticipated, men were dragged in and taught at a feverish rate. Owners competed against one another in an endeavor to fill their shops with anything in the shape of men who could contribute in any degree to capacity production. Many managers conscientiously introduced methods tending to develop recruits into skilled workmen. They achieved a measure of success, but their efforts were nullified to a certain extent, as the efforts of all well-meaning minorities usually are nullified, by the attitude of a selfish majority. In this particular instance the selfishness manifested itself in the readiness displayed in enticing workmen with the offer of higher wages, from the men who had trained them and who naturally had lost money on their initial efforts. The majority refused to introduce any definite training system, but drew their labor supplies, as far as possible, from sources in which the labor had secured at least a preliminary training. Naturally, this prevalent attitude discouraged those who were really sincere in their attempt to provide an adequate supply of skilled workmen.

Even in establishments where training methods were continued, enthusiasm was reduced almost to the vanishing point as a result of the lean years that followed the cessation of hostilities. The volume of war orders made up of demands for military materials and the thousands of other requirements directly traceable to martial conditions obtaining here and in

IS MET AT THE DOOR AND MADE WELCOME

Europe, this mighty volume that had poured for four years in a steady stream into the national mill race, suddenly slowed down to a trickle that barely kept the wheel revolving. For a period during 1921 even the most optimistic manufacturer would not have been unduly surprised to awake some morning to find the machinery of industry standing motionless. There seemed to be no incentive, at least no immediate incentive to provide even a normal army of trained workers and naturally interest in training and training methods received scant consideration. The problem for a time was not so much to find a sufficient

THE INSTRUCTOR INITIATES THE BEGINNER BY SHOWING HIM HOW TO MAKE STARS ON A SMALL SQUEEZE MACHINE

number of workmen as it was to find a sufficient quantity of work to form a reasonable excuse for opening the door every morning, or even three mornings per week. Indeed many a man closed his place at night without any definite assurance that he would open it again the following morning. This condition did not apply in its entirety all over the country, but it prevailed to a most unpleasant extent and also to an extent that influenced public opinion in every field of industry.

Unlimited Resources

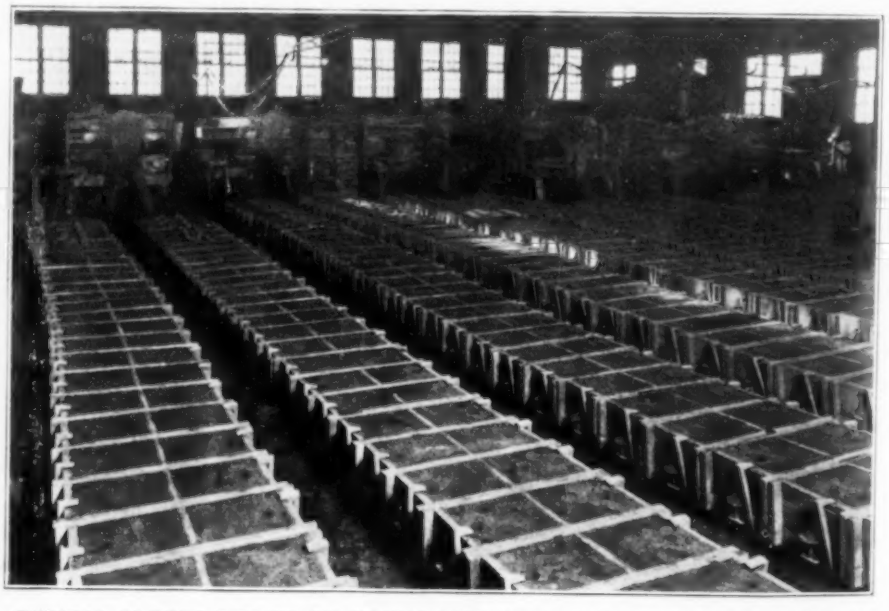
However, conditions gradually righted themselves as they invariably do after every great unheaval, moral, social, economic or political. In the United States the recovery has been quicker than elsewhere. According to popular estimation, which at best is rather hazy even under favorable conditions, ruin was averted by, and the present happy state of affairs is traceable in part to, the huge gold reserve held at Washington. This may be true to a certain extent, but as a matter of fact two other powerful factors exert a more potent influence than the gold reserve on the present and future prosperity of the country. One is that this is the greatest iron producing country in the world and the other is that the population with its ever increasing demand for more iron products, constantly is increasing both in numbers and absorbant capacity. Extensive territory still is available for settlement and reliable sources estimate that the United States ultimately will support a population of 600 millions.

The expansion of the automobile industry alone is sufficient to silence the plaint of the pessimists who always view with alarm the rapidly impending saturation point either in commodities or population. At the beginning of every year for the past 10, members of this melancholy tribe have predicted solemnly that the automobile makers had arrived at the ultimate and positively absolutely last square centimeter of saturation. With equally unfailing regularity, figures submitted at the close of each year have indicated that the production and presumable assimilation each year has been greater than the year before. The production last year was over 4,000,000, or approximately twice what it was three years ago, and according to figures published recently by the department of commerce, the production for 1923 exceeded that of 1922 by approximately one and one-half million. The actual figures for 1922 are 2,586,049 and for 1922, 4,012,873.

Returning Prosperity

Recovery and growth of the automobile trade is fairly typical of corresponding conditions in every line of business. The slack succeeding the war period has been taken up practically in every field and the demand for foundry workers once more closely is approaching the balance point where supply and demand are equal. Foundry managers who foresee a return to approximate war time conditions, although at this time brought on by a natural expansion of business, are beginning to lay tentative lines that will insure an adequate labor supply to meet the anticipated demand. W. B. Greene, president Acme, Palmer & DeMooy Foundry, Cleveland, has had a plan in operation for over a year that it is working out to his entire satisfaction.

It was designed to meet two definite conditions. First to train green labor to a point where its services equal those of any skilled help and second, to hold this help later in



TYPICAL FLOORS PUT UP BY YOUNG MEN AFTER A FEW MONTHS TRAINING EACH FLASK CONTAINS A MOLD SIMILAR TO THE ONE SHOWN IN DETAIL ON PAGE 219

the face of possible competition due to a tight and rising labor market. Up to the present the plan has met all expectations on the first count and the sponsor confidently anticipates that if necessary it will meet the second test in an equally satisfactory manner. His opinion is based on close observation and the intimate contact he has maintained with this feature of his business. To some extent it has been in the nature of a hobby, a desire to try out a theory and naturally he is gratified at the result.

In discussing the general subject of industrial training he admitted that many plans are feasible and almost any one may be adapted to meet local conditions. However, he is emphatic in declaring that the ultimate success of any plan hinges primarily on the active interest displayed by the executive responsible for its operation. Although he had arrived at this conclusion independently and as a result of intuition and observation, he points out that he is not alone. The record of any successful system, any system responsible for results that show on the right side of the ledger, emphasize the same feature. According to his description his system is made up of expediency, recognition of the workman's view point, the golden rule, common sense and a little tact.

The shop is listed in the general light jobbing class and normally gives employment to about 50 molders. Three or four all-around men attend to the miscellaneous, short-order jobs. The remaining men work on the bench and operate squeezer machines and make all the duplicate castings of various kinds that are ordered in large quantities. From the foregoing it is apparent that the problem in this instance is to develop a number of machine operators and match plate bench men on a fairly well standardized line of castings and, therefore, many of the features that confront foundrymen in other lines are missing.

Many curious cases have developed during the year the plan has been in operation. Perhaps the most outstanding is that of the young colored man who heard of the opportunity while working in the navy yard at Portsmouth, Va. He had almost completed the prescribed course at the industrial school for colored youths at Hampton, Va., when war was declared. He was among the first to try for a commission at one of the training camps and failing in that he served as an enthusiastic buck private until mustered out at the close of hostilities. He returned to the school with the intention of completing his course, but split with the faculty over a difference of opinion on some credits which he felt were due him. He had no difficulty in securing a job in the navy yard foundry as a helper and although his chance of eventually becoming a molder under navy yard conditions was exceedingly remote, he acquired a leaning toward the trade.

With thousands of others he was laid off when the military and naval retrenchment policy was placed in force and for a time could not secure employment. This fact coupled with his foundry experiences and inclination rendered him particularly susceptible to the advantages of a job advertised by the Cleveland foundry. He had no money for railroad fare, but he had a fair share of gumption, usually considered an exclusive attribute of the dominant white race, and he came North. He tramped part of the way, secured rides from passing

THIS MOLD FOR A GAS HEATER CASING IS RAMMED BY HAND ON A BENCH FROM AN ALUMINUM MATCHPLATE PATTERN—THE DAY'S PRODUCTION FOR ONE MAN IS 96 FLASKS 11 X 25 WITH A 6-INCH COPE AND A 3-INCH DRAG

automobile drivers and took advantage of any other method which seemed expedient for the time being. Finally he arrived and after he had told his story, immediately was placed at work. He was given an advance on his prospective pay to meet his running expenses until the first regular pay day. It is said that the manner in which he made the sand fly and the avidity with which he assimilated instruction during the succeeding weeks was a source of the keenest pleasure to the old instructor. Today, and for several months past, the same young man is putting 96 molds a day and drawing $100 every two weeks.

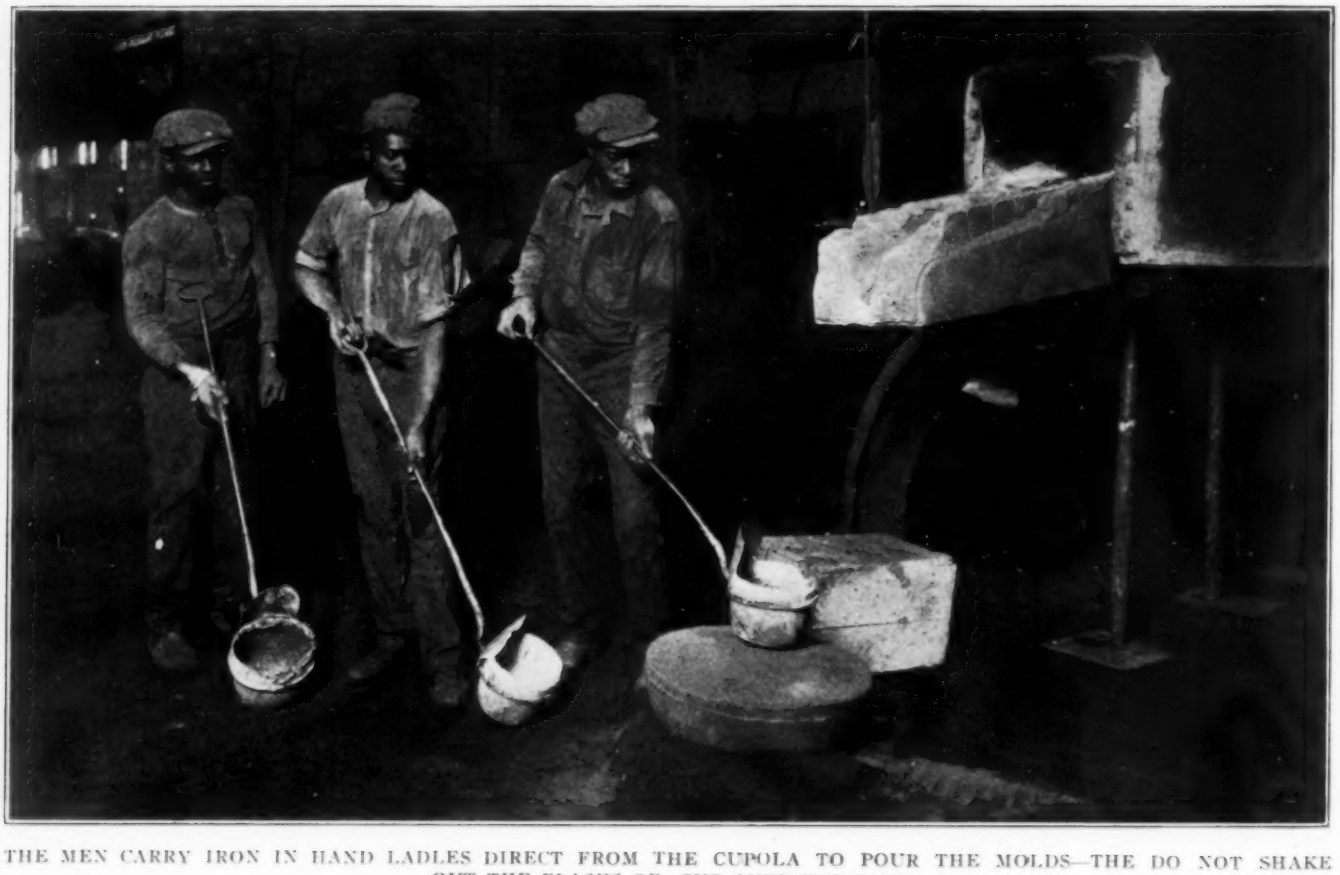
The manager of this foundry had a fairly definite idea of what he wanted before he started. Also, although he had a definite plan outlined in his mind, he approached the subject with an open mind that would allow him to make any changes necessary to conform to actual operating conditions. However, at the close of the year he found that his original plan was perfectly feasible and was responsible for adding 12 skilled and loyal men to his force. He proposes to hire no more skilled men in future, but in the event that they leave one or two at a time in the future as workmen have a habit of doing, he will replace them with green recruits educated through a short and intensive course of training.

The improvers class in common with every other department of the foundry is under the jurisdiction of the foundry superintendent, but it is treated as an individual unit under the direct charge of an experienced foreman. The sole duty of this man is to act as instructor and demonstrator. He shows the new men how to operate their machines under the most favorable circumstances. He instructs them in the fine art of cutting corners and reducing the number of necessary motions to a minimum. He explains in intimate detail all of the many causes responsible for defective castings, and tells them how to distinguish between sand that is properly tempered and sand that is not fit to use because it is either too dry or too wet. He explains the danger of employing weak bottom boards, worn guide pins and loose patterns. Also, he instructs them on the various features connected with the proper care and operation of their machines and in that manner eliminates the cause for many delays.

The entire original class is recruited from English speaking young men, both white and colored. The manager felt he was placing a sufficiently heavy burden on the shoulders of the instructor without requiring him to impart instruction to candidates ignorant of the language. Situations that require instant and tactful explanation constantly present themselves during the training period and occasionally afterward. Probably in a pinch, any capable young man might be employed irrespective of language limitation, but up to the present no difficulty has been experienced in securing a sufficient quota of English speaking candidates. In fact several names now are on a waiting list.

No pretense is made that this is an apprenticeship course in the ordinary sense of the term, or that the young man will be transformed into an all around molder in the course of a few months. He is told frankly that he will be taught how to handle a few jobs so that in a short time he will be as skilfull as any other employe and that he will be paid on a piece rate basis. During the first one or two weeks he is paid the current laborer's rate. Usually during that time his output of good castings does not justify the wage received, but the manager figures the difference as a legitimate expense or investment to be charged against op-

(*Concluded on Page 232*)



THE MEN CARRY IRON IN HAND LADLES DIRECT FROM THE CUPOLA TO POUR THE MOLDS—THE DO NOT SHAKE OUT THE FLASKS OR CUT OVER THE SAND

SPECIFICATIONS FOR GAS WELDING RODS

(*Concluded from Data Sheet No.* 516)

Marking

All bundles, coils, boxes or kegs shall be provided with a metal, linen or strong fiber tag securely wired to or in the case of boxes or kegs nailed on the outside, bearing the following information:

Make.....
Specification Number.....
Diameter.....
Nominal Weight.....

Ordering

Material ordered under these specifications shall be known as:

Gas Welding Rods, American Welding Society Specifications No. 1, revised May 1, 1921.

All orders should be specified in pounds.

In addition, requisitions shall show the following:

Specification Number.....
Size.....
Packing.....

As a guide in ordering, the following information is of use:

Size, inches	1/16	3/32	1/8	5/32	3/16	1/4	5/16	3/8
Lb. per 100 ft.	1.04	2.3	4.1	6.5	9.3	16.7	26	37.5
Ft. per 100 lb.	9615	4273	2403	1537	1067	600	383	266
Mils	63	94	125	156	188	250	312	375

CHEMICAL ANALYSES OF SPECIAL ELECTRODES

General

Coated and covered electrode have a distinct field in arc welding, but the welding wire specification committee of the American Welding Society does not recommend any chemical analysis of material, forms of coating or covering.

The data following are the result of investigation by the committee and are offered as a guide in the selection of welding material of the nature described. The analyses must not be considered a direct recommendation as investigations have not been completed which permit the preparation of specifications for this class of material.

Coated and covered electrodes afford a broad field for research and specifications will be prepared for such electrodes as determined.

Sizes

1/8, 5/32, 3/16, 1/4, 9/32 and 5/16-inch diameters.

Chemical Composition

The chemical composition shall be within the following limits for the uses specified:

Low Carbon Iron or Steel

No. 1

Carbon	not over 0.06 of one per cent
Manganese	not over 0.15 of one per cent
Phosphorus	not over 0.04 of one per cent
Sulphur	not over 0.04 of one per cent
Silicon	not over 0.08 of one per cent

No. 2

Carbon	0.13–0.18 of one per cent
Manganese	0.40–0.60 of one per cent
Phosphorus	not over 0.04 of one per cent
Sulphur	not over 0.04 of one per cent
Silicon	not over 0.06 of one per cent

(*Continued on Data Sheet No.* 519)

THE FOUNDRY DATA SHEET, MARCH. 15, 1924
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

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MANUFACTURERS OF IMPROVED CORE ROOM EQUIPMENT
ENGINEERS. MACHINISTS AND FOUNDERS

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September 21, 1923.

The Penton Publishing Company,
Cleveland,
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Attention: Mr. J. D. Pease:

Gentlemen:

It is a great pleasure for us to write you, expressing the satisfactory results which we have had from our continued ad in your Publication THE FOUNDRY.

We have been a constant advertiser for the last 20 years, and can truthfully state that more than 75% of the inquiries which we receive come from readers of your paper, and at least 50% mention the fact, both in this Country and Abroad.

We believe that it would be a great mistake on our part, to discontinue this method of bringing to the attention of the Foundry Trade our Core Making Machines and other Core Room Equipment that we manufacture, as we know of no other medium at this time, that would give us the results that we have had, and are getting through you.

Thanking you for the courteous, and prompt manner, in which all our demands and requests have been handled, we beg to remain.

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Methods and Equipment Employed in the Production of Large Castings Reflect the Crystallized Experience of Expert Foundrymen Over a Period of Many Years

BY PAT DWYER

STEAM plates for rubber factories present typical examples of how molding methods in the Farrel Foundry & Machine Co., Ansonia, Conn., are adapted to meet extraordinary conditions. Where a foundryman decides to pour a small plate on edge instead of on the flat, he experiences no particular trouble provided his sand is firm, his flask rigid and his clamps properly applied. However, when the mold is magnified to a degree shown in Fig. 2, it is apparent that while the principle may remain the same the method of application will show a marked difference.

These plates vary from 6 to 9 feet in width and from 10 to 40 feet in length. For convenience they are known as plates but in reality they represent double plates united at the sides and ends and by numerous openings through the flat cores that form the steam chamber on the interior of the finished casting. Formerly, the castings were molded flat in green sand but the risks were enormous and the many hazards that always attend heavy green-sand molding suggested the advisability of adopting a more satisfactory method. The system of making the mold illustrated in Fig. 2 and 3 was suggested by one of the molders several years ago at a time when the company had a policy in force which paid workmen a bonus for workable suggestions tending toward improved or economical operation. From the illustration it will be noted that the entire mold is dried, a feature that under ordinary circumstances insures a clean skin, absence of dirt in the iron and accurate dimensions. Another commendable feature about this method is that the various parts may be prepared independently and the mold may be assembled by molders who do not need to be so highly skilled as those required to produce similar castings in green sand molds.

To withstand the strain incident to casting a large quantity of metal in the position indicated a suitable pit was prepared surrounded by heavy iron plates reinforced on the outside by I-beams braced in place. The excavation on the outside of the iron plates then was rammed solidly full of sand. The expense and time involved in preparing a pit of this character with rigid walls capable of withstanding successfully any strain that might be brought to bear against them was felt to be justified in the fact that steam plate castings steadily are on order.

The pit is bricked permanently on one side for a foundation on which to spread a coating of loam designed to serve as one face of the proposed mold. A space of about 4 feet separates the brick wall from the iron plates forming the opposite side of the pit. This space provides ample room for the workmen engaged in assembling the various parts of the mold.

Now that the pit has been finished and placed in use the opening in the floor does not appear so formidable when compared with pits prepared for other

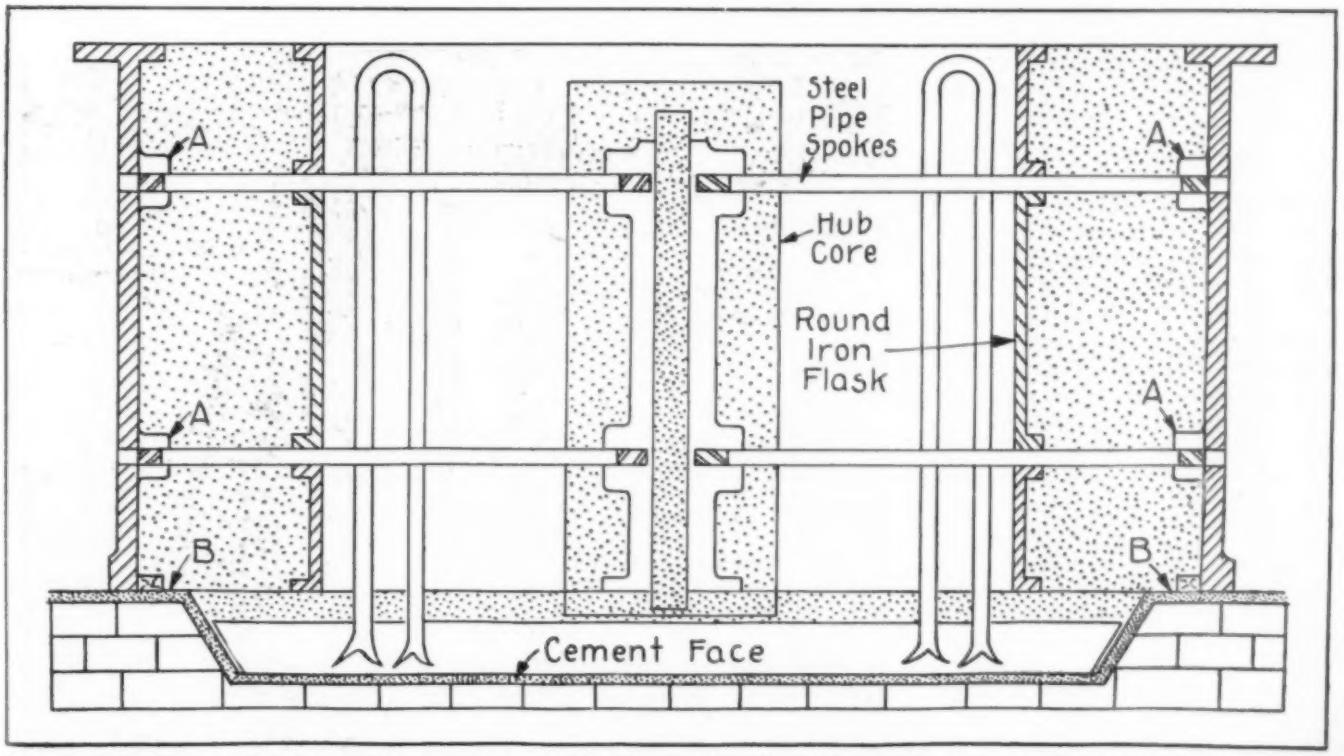


FIG. 1—SECTIONAL VIEW OF IRON COREBOX IN PLACE ON CEMENT FACED CORE SEAT—IRON FLASK RINGS APPROXIMATELY 3 FEET LESS IN DIAMETER THAN THE COREBOX CONSERVES THE AMOUNT OF SAND REQUIRED TO FORM THE CORE

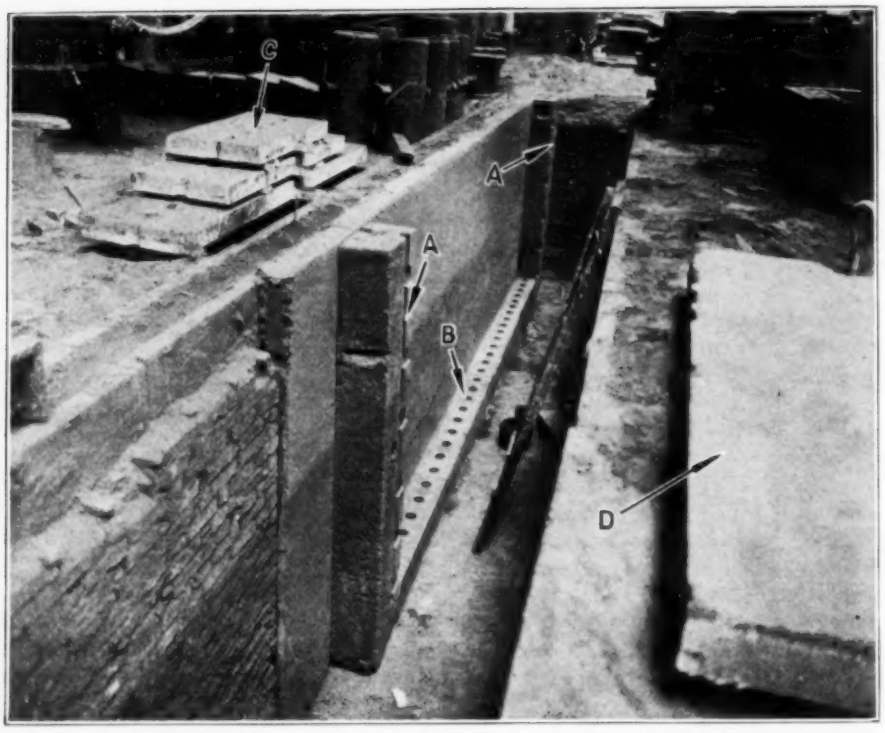


FIG. 2—MOLD FOR STEAM PLATE WITH BOTTOM AND END CORES IN PLACE

castings, or when considered in relation to the general run of castings, molds and equipment in evidence all over the foundry. One mold is assembled after another in regular sequence, poured, shaken out and the casting removed as a regular routine performance. The men who assemble the mold are not troubled with any misgiving or any doubt on whether the foundation and side walls will withstand the pressure and carry the load. All that has been provided for in a structure of steel and concrete surrounding the pit on the bottom and on all four sides.

The original excavation resembled a cavity in the ground prepared for the foundation of an office building or a bridge, more than a pit in which to make molds in a foundry. The resemblance was still more marked after the frame work of steel beams, rails, plates and tie rods was erected in place with the upper members flush with the foundry floor. In this instance the term foundry floor is rather indefinite, since the surface constantly is in a state of transition alternating between piles of sand and holes of varying depth for the reception of patterns. A more accurate description would be to say that the top members of the steam plate pit frame were adjusted to lie on the same level as the permanent concrete gangway which extends along the center line of the foundry floor from one end of the building to the other. In addition to its legitimate purpose as a gangway, this concrete strip serves as a guide to men working on both sides in adjusting their patterns at approximately the same level under all circumstances.

The analogy between the foundation frame and that of a bridge differs to the extent that in the latter case a superstructure finally is erected and imposes a permanent load on the foundation. In the steam plate mold foundation the load is not constant, but the ability to support it at each recurring peak period when the mold is filled to the top of the risers with liquid iron is just as necessary as in this first case.

The pit is long enough to accommodate a 40-foot casting, but when shorter castings are ordered the pit is stopped off in the same manner that any molds large or small are treated in a foundry. A little more time, material and rigging are required to fill a gap 4 feet wide and 9 feet deep than might be necessary in a mold for example made in a snap flask, but the principle is the same. It is largely a matter of proportion. Men become accustomed to their surroundings and where everything is done on a large scale, they measure everything in tons instead of pounds and refer to measurement of patterns and flasks in terms of feet instead of inches.

The only pattern equipment employed on these castings is a set of straightedges and a few coreboxes. When a casting of a certain length is ordered the foreman patternmaker, in person or by deputy, checks up on the adjustable coreboxes and having made any necessary changes, sends them to the foundry. The cores are assembled in certain definite combinations to form a casting of any required dimensions, of course within recognized limits, and since all the details are predetermined in the office and pattern shop before the pattern equipment is sent to the foundry the molder is relieved of the necessity of figuring contraction allowance when preparing the mold. With the exception of the back wall which is continuous, the other component parts of the molds are made up in several parts and the molder's duty consists in assembling them into a com-

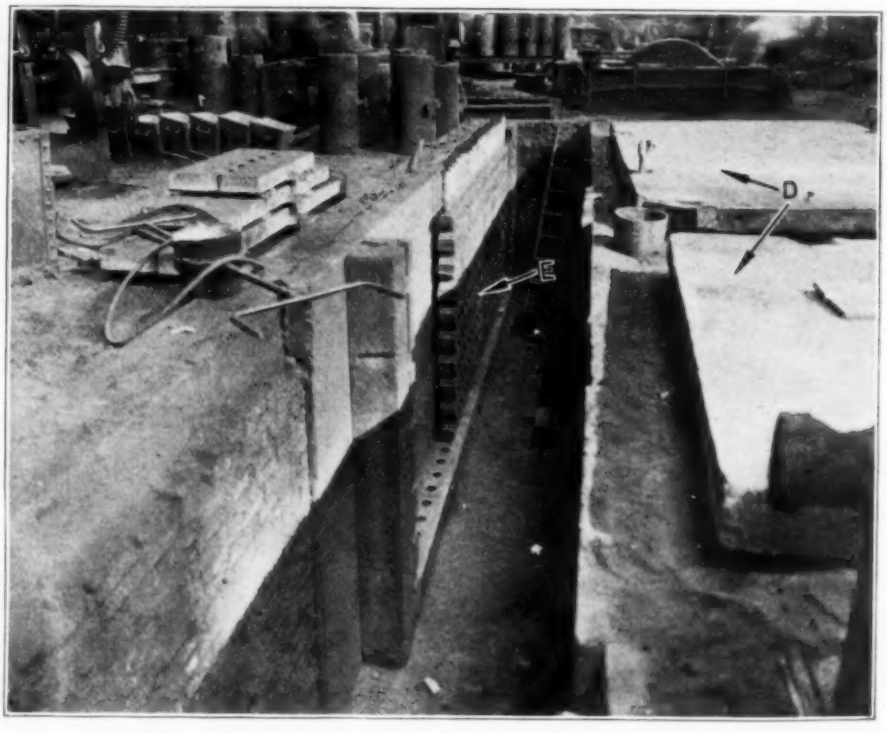


FIG. 3—SAME MOLD SHOWN IN FIG. 2 WITH SEVERAL OF THE STEAM CHAMBER CORES IN PLACE—THEY ARE HELD UPRIGHT TEMPORARILY BY WIRES FASTENED TO RODS DRIVEN IN THE FLOOR

plete mold. The back wall of the mold is dried in place, but the sectional front wall, the chamber cores, bottom and end cores and the cover plates are dried in the core and mold ovens.

Steam chamber cores are made from an oil sand mixture. The system of venting is similar to that employed in cores for hot-water, boiler sections. Rods are inserted through openings in the sides of the corebox and extend between the upright blocks from one side of the box to the other. The rods touch the perforated pipes that serve the double purpose of arbor and vent pipe and are removed after the corebox has been rammed full of sand. Additional rods are laid in the sand above and below the three long pipes to serve as reinforcement.

Loamed plates *D* Figs. 2 and 3, are swung up on the edge and lowered in place close to the cores to form the second flat wall of the mold. The end cores and bottom cores automatically locate the plates in their proper position at those points and dowel pins at the joints locate the plates in between the two plates at the ends of the mold. Cover plates shown at *C*, Fig. 2, with openings for the core prints extending through from one side to the other are lowered into place and complete the mold.

With the first molds made in this manner it was customary to ram the entire space between the loam plates and the wall of the pit, full of sand. This method involved a considerable amount of work on the part of several men both in filling the pit and afterward in excavating it for the reception of another mold. In addition to the actual work, difficulty was experienced in getting men at night to go into a hot pit to dig sand. Finally a plan was adopted that saved considerable time, eliminated the labor of several men and did not detract from the safety or rigidity of the mold.

Chills Used for Blocking

After the mold is assembled a number of roll chills large enough to approximately fill the space between the loam plate and the back wall of the pit, are lowered into place and wedges are driven between the chills and the plates. The vertical joints between the plates are daubed with mud and sand is rammed in the bottom of the pit to a depth of about 2 feet.

Where a plate does not occupy the entire length of the pit, a plate, backed by a few chills is erected outside the end core and the space between is rammed full of sand. Chills also are employed as weights to hold down the cover plates and the steam chamber cores. Rails resting on both sides of the pit are employed to support the chills and after a sufficient number has been arranged, wedges are driven between the rails and the upper surface of the covering plates. Additional wedges are placed between the rails and the top ends of the vent pipes. The vent pipes as previously stated extend through the core and serve as chaplets top and bottom to maintain it in place. Immediately after the casting has set it becomes necessary to remove the wedges so that the pipes may expand without distortion.

The service of one man in addition to the craneman is all that is required to remove the chills and other rigging to strip the casting and convey it to the cleaning room. Afterward a grab bucket suspended from the crane removes nearly all the sand from the bottom of the pit and places the pit in readiness for another mold. No more heavy hand digging is needed.

Another interesting example of molding practice and one that reflects the skill and training of the man responsible for the method that was adopted is shown in the drum 8 feet diameter, 8 feet face illustrated in Fig. 8. The picture was taken on the floor of the erecting shop and shows the drum assembled, but for convenience in handling and on account of the metal thickness and the fact that the face had to finish prefectly smooth and clean, the casting was made in two parts which afterward were bolted through an internal flange. In addition to producing castings true to shape and accurate to dimensions, the method adopted also was responsible for turning out one casting a day until the order of twenty was completed.

The rigging required for making the castings includes two heavy lifting plates for supporting the body of sand forming the interior of the mold, these plates were employed on alternate days, one in the core oven and one in the mold. Each plate is tapered to a 60-degree angle on the edge to facilitate lifting it into and out of the core print and is provided with four strong hooks to which the crane chains are attached. In this connection it is interesting to note that the hooks are spaced in a manner to clear the body of sand forming the core and therefore when they bent inward under the pull of the crane they did not disturb the sand.

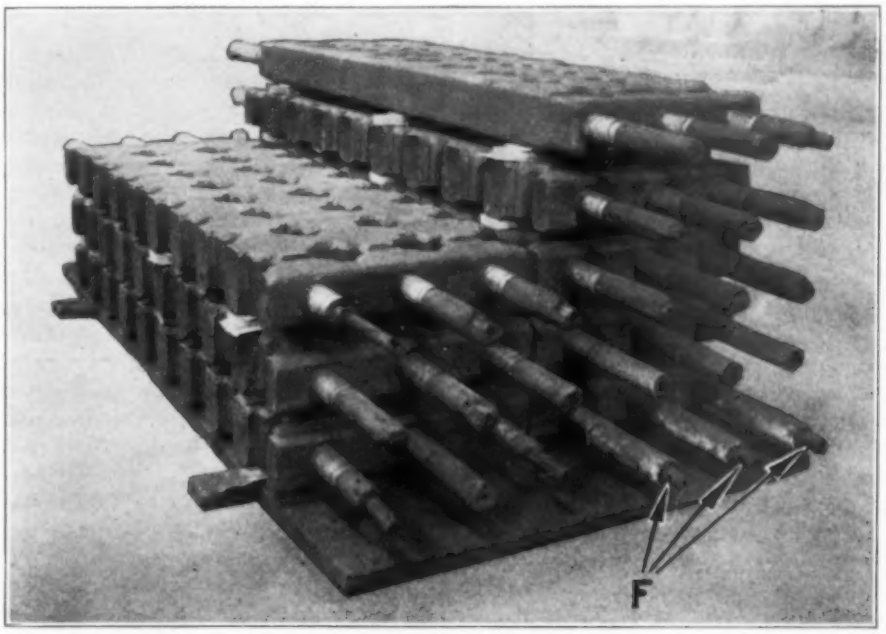


FIG. 4—SHOWING SEVERAL DETAILS IN CONSTRUCTION OF STEAM CHAMBER CORES, INCLUDING PIPE ARBORS, TIN WRAPPING AROUND PRINTS AND HOLES IN END OF PIPES BY WHICH THE CORES ARE LIFTED

Other rigging includes one cast iron corebox machined on the inside and provided with 16 openings corresponding to the position of the ends of the spokes. The corebox shown in Fig. 6 was cast in a loam mold and the spoke openings instead of being drilled afterward, were cored in place. In this instance the small cores were placed so accurately by the molder that when the machinist had finished the interior he ran a pair of test marks all around and found that each row of holes was truly in line and accurately spaced. Four lugs spaced equidistantly on the outside of the upper edge of the corebox serve as handles in lifting the corebox form the core or in transporting it from place to place. A taper of ⅛-

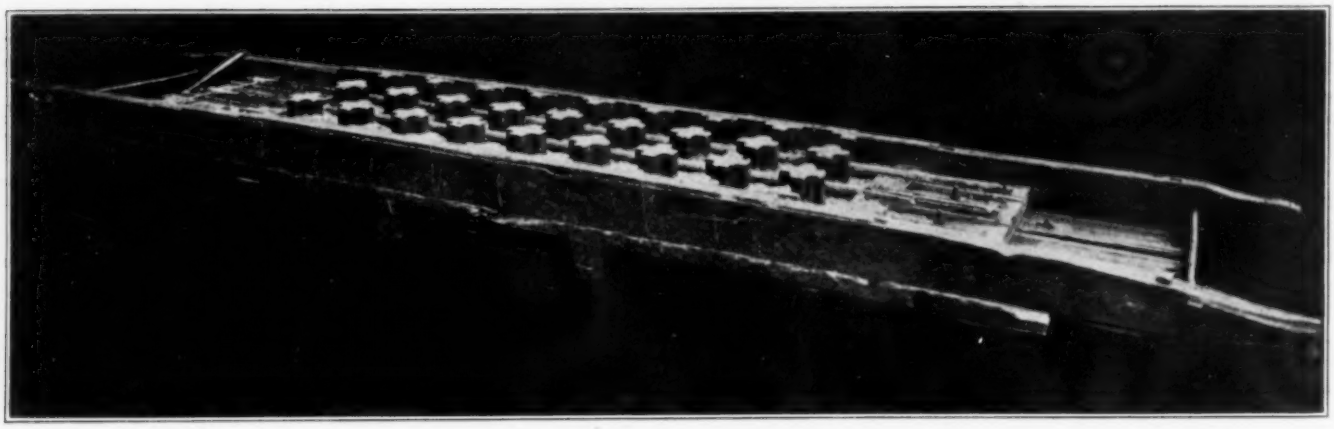


FIG. 5—INSTEAD OF CAST IRON ARBORS THE CORES ARE REINFORCED BY WIRING TRANSVERSE RODS TO THE LONG PIPES WHICH ALSO SERVE AS ANCHORS AND VENTS

inch was turned on the inside face of the corebox which serves the double purpose of facilitating the removal of the box from the body of sand forming the core and also compensates for the strain on the lower part of the mold and core while the mold is filling with iron.

The outside of the mold was made in a pit in the floor and dried in place. Beyond a coat of blacking and a little patching occasionally, the outside wall of the mold required no further treatment and served for the entire lot of 20 castings. The contraction was sufficient to clear the casting from the face of the mold and by adjusting the chain to lift the casting plumb, the wall of the mold was not disturbed. On account of the arms it was necessary to provide an entire new core for each casting.

A seat was swept flush with the floor level on which to ram the cores. Instead of the usual loam coating a thickness of cement was spread on the brick work and finished smoothly to represent a seat for the lifting plate and another for the lower face of the corebox. The general arrangement will be more readily apparent by referring to the sectional view of the corebox and core shown in the illustration, Fig. 1.

The core print was made two inches deeper than the lifting plate to provide a 2-inch thickness of sand on top of the latter. The principal reason for this was to make room for the slab core designed to form the flange end of the hub. By refering to the illustration, Fig., 8, it will be noted that the two halves of the casting are bolted together through a flange on the hub and an internal flange on the rim. A second reason for keeping the lifting plate below the level of the corebox face was to provide a seat for the core that would seal the opening and prevent any iron from leaking down under the plate. This feature is illustrated at *B* in Fig. 1.

The iron corebox was adjusted in place on the cement finished seat. The lifting plate then was lowered into position after which sand was rammed on top of the plate and struck-off level with the horizontal parting line shown at *B*. The slab for the bottom face of the hub was located in the center and with the face flush with the green sand face. In this manner the lower face of the hub and the lower face of the rim of the drum were sure to come on the same plane and therefore would present no difficulty in the machining operation preparatory to joining the two halves of the drum together as it appears in Fig. 8.

The upper internal flange was cast integrally with the corebox, but the lower flange was made up of a number of wood segments adjusted in place by laying the segments on the flat parting shown at *B* Fig. 1 and then pushing them close to the iron ring. A row of rods was rammed over the flange all around to support the sand after the segments were removed.

A ring, 8-feet in diameter, contracts approximately 1 inch while cooling which means that in wheels of this character where the cast-iron rim and hub are connected by steel spokes it is necessary to cast the rim on one day and the hub on the following day. The metal in the hub contracts a little, but the only effect is to place a slight tension on the spokes. To prevent the steam and gas generated during the pouring process from surrounding and permeating the hub core three iron flask rings were rammed up between the face of the corebox and the hub core. In addition to preventing the steam from working through, the flasks reduced the amount of core sand required for each core and correspondingly reduced the time occupied in making the core. The flask rings

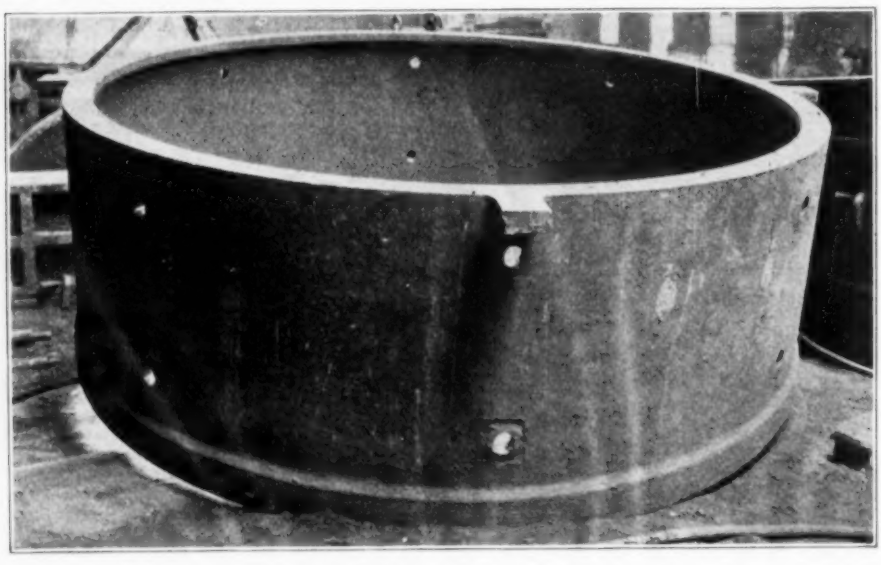


FIG. 6—AN IRON COREBOX ACCURATELY MACHINED ON THE INTERIOR WAS PROVIDED FOR MAKING THE INTERIOR OF THE DRUM—THE STEEL SPOKES WERE PROPERLY LOCATED AND HELD IN PLACE DURING THE RAMMING OPERATION BY SUITABLE HOLES EXTENDING THROUGH THE WALL OF THE COREBOX

were set one at a time as the ramming progressed and in a manner that did not interfere with setting the spokes. The top and bottom rings were removed from the casting readily in the cleaning room, but the center ring had to be cut in two before it could be removed from between the arms. The same set of rings served for all the drums.

Hub Core In Two Parts

One half corebox served to make all the hub cores. Usually in wheels of this shape the hub core is made in a number of sections which then are built on top of each other. In this instance the hub core was considered as a unit and split in two vertically. The two halves afterward were pasted and also bolted together through projecting lugs on the arbors as shown on the core illustrated in Fig. 7. Suitable hooks were provided on the top of the core for conveying it from the coreroom and lowering it into the mold.

The spokes were cut from steel pipe and plugged at each end to prevent the iron from entering. A ¼-inch hole was drilled through each arm about midway between the rim and the hub to allow the heated air to escape. The wood hubs *AA*, Fig. 1, on the rim end of the arms were located automatically and held in place by sliding the arms through them. The outer end of the arm rested in the opening in the corebox and the inner end rested in a corresponding opening in the hub core. After the core was rammed to the top, the arms were pushed in far enough to clear the corebox which then was rapped and removed. With the corebox out of the way, the wood hubs were drawn out of the sand quite readily. The segments forming the lower flange were drawn in the same manner and then the core was blackwashed and placed in the oven to dry. A loamed plate to serve as a cope was dried at the same time.

In assembling the mold, the drag was brushed clean and prepared for the reception of the core by sprinkling a little flour on the core seat. The core was lifted off the car by four chains terminating in turnbuckles by which the load might be adjusted to hang perfectly plumb and level. Four sticks, 4 feet in length, square in cross section and a little less in thickness than the required thickness of the wall of the casting were spaced upright and equidistantly close to the wall of the drag and guided the core into its place in the center. The core was lifted out once so that the man in charge of the job might satisfy himself that it fitted properly around the lower edge. If necessary any little depressions were filled and then a dough worm was laid in a ring around the bottom and the core was lowered back to place.

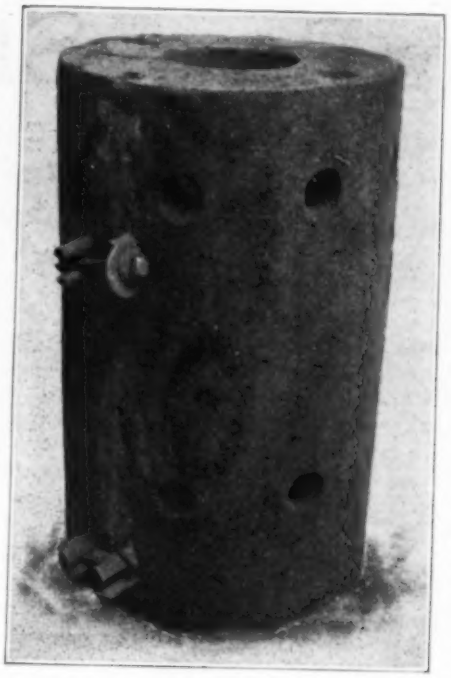


FIG. 7—ONE OF THE HUB CORES

The plain, loamed cover ring was provided with eight 6 x 3-inch openings spaced equidistantly on an 8-foot circle. A runner stick, 2 x ½-inch, was adjusted in the center of each opening and after the opening was filled with loam and the upper surface slicked the runner stick was removed. No seat was provided on the mold to serve as a guide in locating the cover plate. A man stood by each of the four handles of the plate as it descended and by holding a small rod suspended through one of the gate openings he determined when the gate was in the line with the vertical cavity of the mold. Absolute accuracy was not essential since the face of the plate was perfectly flat. The gates were spaced as nearly as possible to come in front of each arm and thus furnish hot iron to fuse the ends and take a firm grip.

Runner Basin Made of Two Rings

The runner basin was made up of two rings, one inside the gate openings and the other on the outside. Gate sticks were inserted in the various openings while the basin was being made up in green sand. A few roll chill were set on for weights and the casting was poured. On the following day the casting was lifted out of the mold and set down at another point on the floor where the hub was poured.

A peculiar feature was noted in connection with this job which illustrated the vagaries of pipe when

(*Concluded on page 229*)

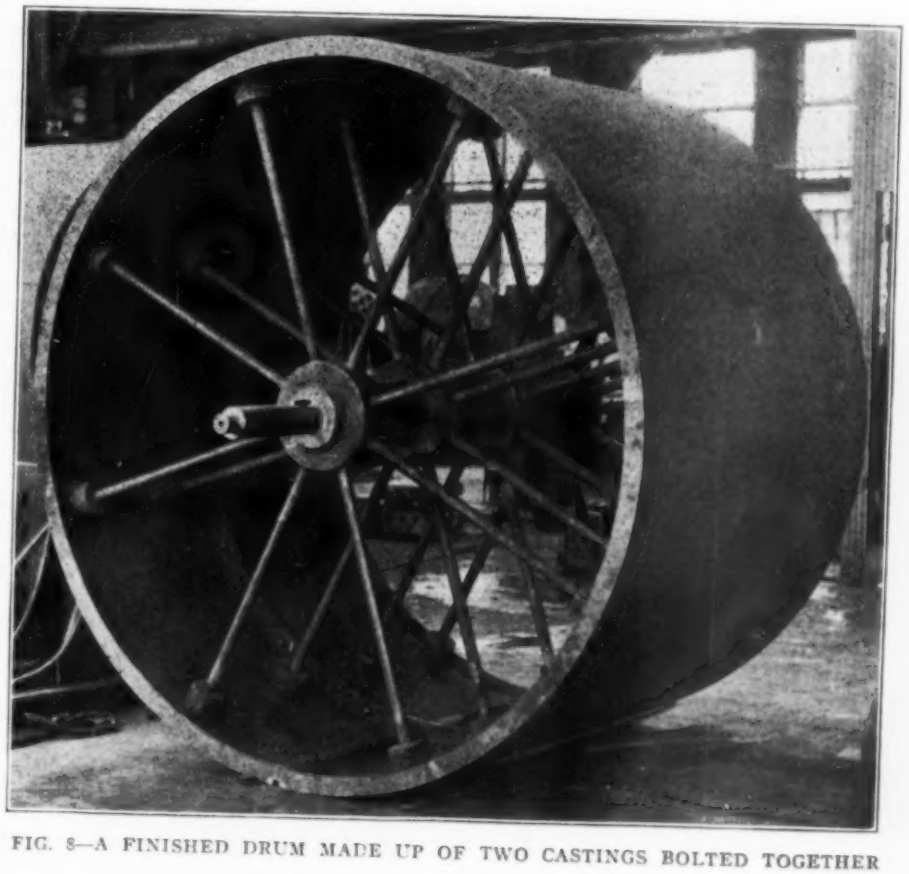


FIG. 8—A FINISHED DRUM MADE UP OF TWO CASTINGS BOLTED TOGETHER

Controlling Brass Shop Detail

Close Tab on Weights, Mixtures and Other Data Is Checked on Operations in Nonferrous Foundry—Charts Shown Which Help to Record Operations and Metal Compositions and Properties

BY FRANCIS W. ROWE

WITH increased knowledge of metallurgy, scientific control has been established in the foundry industry. Needless to say, every brass foundry making any pretence of high class or specialized work should have the services of a metallurgical laboratory at its command. To secure the highest efficiency from a laboratory it is essential that the closest co-operation should exist between it and the shops. The failure of laboratories, in some cases, to realize the high expectations which preceded their installation nearly always can be traced to lack of thorough co-ordination with the shops, due either to the antipathy or prejudice of the practical man. Too often the scope of the laboratory is so restricted that any excursions beyond the field of chemical analyses or physical testing are regarded as interference or impertinence. Happily, this trend of thought is gradually passing away as the practical man realizes that only with the help of the scientifically trained mind can he successfully hold his own in competition with other shops.

The most certain way to insure that the laboratory shall be a real and invaluable adjunct to the brass foundry is to place every item of information at its disposal regarding the workings, costs, etc., and invite its opinion on each and every detail of procedure. The efforts of the laboratory to improve the quality or lessen the cost of the finished product are always more or less abortive unless the system records and costing on the part of the works managers' and accountant's staff is comprehensive and accurate. It is only by this means that the experience of a foundry becomes an item of value, and repetition of old mistakes and troubles can be avoided.

The system of record keeping sould be so arranged as to include all data likely to be of value and to give vital statistics at a glance. The following is an outline of a procedure calculated to supply these essentials for an ordinary brass foundry and insure that a high standard of quality is maintained. It also is intended to enable the *man at the wheel* to detect the money-eating troubles and suggest improvements with comparative ease.

In all nonferrous foundries one of the primary essentials is the store department of adequate dimensions—too large rather than too small. This

COPPER	Brand Best Selected		Ref. No.
Suppliers	Niles Monklionse & Co. Swansea		
Quantity	50 tons	Delivery Date 26-3-22	Price Per Ton £62/10/-
Stored in Bins No.	17, 18 & 19		
To be used for mixings No.	1, 2, 5 & 9		
Remarks	Copper Content Rather Low Microscopic examination Showed Fair amount of Oxygen. Not so Good as Last Delivery under Ref No. 1436		
Storekeeper	J.E. Brown	Metallurgist	N.F. Rankine

FIG. 1—ALL PURCHASES OF INGOT METAL SHOULD BE RECORDED WITH THE ANALYSIS OF THE METAL

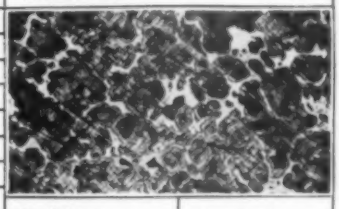
ALLOY NO. 1	Name Admiralty Gun Metal		
ANALYSIS		Mixture		
Copper	88·0	Material	Grade	Per 100 lb.
Tin	10·0	Copper	2	88
Lead	70·5	Block Tin	1	10
Zinc	2·0	Pig Lead	-	-
Iron	-	Spelter	2	2·3
Phosphorus	-	Phosphor Tin	-	
Nickel	-	Phosphor Copper	-	
Aluminum	-			
		Maximum % of Scrap		33%

ANALYSES	Their Analysis	Our Analysis
Element	Their Letter 16/3/22	Date Reptd 1/4/22
Copper	99·67	99·56
Arsenic	0·092	0·143
Lead	0·038	0·032
Antimony	0·030	0·039
Oxygen	-	-
Iron	-	0·015
Bismuth	-	0·006
	Analyst	H. B. Thomas

PHYSICAL PROPERTIES:—							
Yield Point	Maximum Stress	Elongation on 2 in.	Red. of Area	Brinell Hardness	Impact		
-	15	10	10	60	5·0	Minimum Requirements	
7·5	16·5	15	15	70	8·5	Average	
Casting Temperatures—Degrees Cent.							
Section	½"	¼"	½"	1"	2"	3"	4"
	1140	1110	1080	1050	1030	1020	1010
General Instructions							
Melt copper (plus scrap) under heavy layer of charcoal Draw the pot, add block tin, then spelter, stir well skim & pour							
Metallurgist N.F.R.							

FIG. 2—INSTRUCTIONS BY THE METALLURGIST SHOULD CONTAIN THE ANALYSIS OF THE ALLOY TO BE MADE AND THE METAL TO BE USED

Crucible No.	1784	Started	18/1/22
Suppliers	Joseph Johnson & Co.	Delv'd	21/12/22
Size	120 W	Grade	3 X
Furnace man	T. W. Jordan	Working on	No 2 Alloy
Total No. of heats	43		43
Total metal melted			3878 W
Cause of failure	Leak near top		
Remarks	Fair average life Probably crushed with too small tongs		

TEST BAR—ALLOY 2		Date Cast 17/3/22	Ref. No. 2341
Analysis		Microstructure	
Copper	89·21		
Tin	9·66		
Lead	0·32		
Zinc	0·24		
Iron	0·08		
Phosphorus	0·336		
Nickel	nil		
Aluminum	nil		
		Condition	As Cast
		Section	Cross Tensile
Analyst	S. B. Jones.	Etching	Ammn. Persulph.
Date Reported	20-3-22	Magnification	100

DETAILS OF LIFE OF CRUCIBLE

Date	Weight	Date	Weight	Date	Weight	Date	Weight
18-1-22	100	20-1-22	100	24-1-22	100	27-1-22	63
—	110	—	100	—			
—	100	—	84	25-1-22			
—	100	—	112				
—	100	—	100				
—	100	21-1-22	100				
—	60	—	60				
19-1-22	100	—	90				
—	100	—	45				
—	115	23-1-22	100				
—	75	—	100				
—	100	—	75				
—	100	—	50				
—	44	—	100				

PHYSICAL TESTS MADE — Test book — Page

Mark	Dia.	Area	Yield Point	Max. Stress	Elong. 2"	Red. Of. Area	Fracture
2A	·564	·250	9·27	18·9	14	16·3	Sound
2B	·564	·250	9·43	16·2	10	9·8	Slight Flaw

Izod Impact	Hardness Brinell	Hardness Scleroscope
10·5	84	-
9·5	80	-

Charge Sheet No. 13966.

Remarks: Lead & Zinc Contents Good
Physical Tests Fairly Good Casting Temperature Obviously Shade high

Metallurgist N.F. Rankine.

FIG. 3—RECORDS SHOULD BE KEPT OF CRUCIBLE PERFORMANCES TO SET A BONUS AND FOR COMPARISON PURPOSES
FIG. 4—RESULTS OF CHEMICAL AND PHYSICAL TEST SHOULD BE RECORDED ON THE SAME CARD

department should be put in charge of a storekeeper of high intelligence, not, as is frequently the case, a glorified laborer or superannuated clerk. This man preferably should not be under the control of the brass foundry foreman, but be directly responsible either to the works manager or the costing department. The functions of this general store department are varied and may be summarized as follows:

The receipt and issue of all raw material for the foundry in the shape of metals, fuel, crucibles, etc.

The reception, segregation, classication, etc., and subsequent issue, of all scrap from the machine shops.

The receipt and issue of all castings, gates, heads and over metal from the foundry, and the weighing out and issue of the same.

COKE	Brand	Hazlehead No 2	Ref. No. 3935
Suppliers	Wright & Rothesham		Price -
Quantity	20 Tons		Delv'd 21-3-22
Analysis			
Moisture	2·44	Calorific Value	
Ash	9·34	B. T. U'S	12·762
Volatiles	0·90	Calories	7·090
Fixed Carbon	89·76		
Sulphur	·92		
Remarks			
Ash very fusible		clinkers badly	
Storekeeper	J. Brown.	Metallurgist	N.F. Rankine

FIG. 5—ALL DELIVERIES OF COKE SHOULD BE ANALYZED AND RESULTS RECORDED ON A CARD

The weighing out of all mixings and metal charges for the foundry.

The superintendence of all scrap recovery plants.

The compilation of all records regarding the foregoing functions.

The store room should be provided with several weighing machines of different ranges covering the whole gamut from ounces to tons. Needless to say, these should be overhauled frequently and checked. They never should be allowed to run over two months without checking, and the amount of their error recorded. Numerous bins and compartments should be provided so that every grade, class and delivery of new material and scrap can be properly segregated.

It is essential for the accuracy of costing and maintaining a high quality of work that all scrap of foundry production should be returned to the store room before being remelted. All purchased ingot metal, etc., on delivery should be passed to the store room. The storekeeper should fill in his portion of an index card, Fig. 1, procuring the requisite information, where necessary, from the purchasing department. This card then should be passed to the laboratory with the nececessary samples for analysis. The laboratory should complete its portion of the card, dupli-

cate it for its file, and return the card to the storekeeper who is then free to issue the material for use in accordance with the instructions from the metallurgist embodied on the card. The purchasing department also is informed of the quality of the material.

All crucible charges should be weighed in the store room in accordance with instructions from the metallurgist. These instructions should be standardized as far as possible for each alloy, as in Fig. 2. A complete set of instructions also should be in the hands of the foundry foreman. Crucible charges should be weighed against instructions from the brass foundry foreman who should anticipate his requirements a day ahead.

Requisitions from the brass foundry for metal all should be written to avoid subsequent discrepancies and disputes. The charges after weighing should be checked by another of the store room employes to minimize the possibility of errors. These charges should be placed in suitable tins or boxes which have the number of the alloy clearly painted on them. If the different components are added to the crucible at different periods of the heat, these tins should be suitably divided into compartments and any powdered or shotted additions or deoxidizers, such as silicon or manganese copper, enclosed in paper bags.

For every alloy complete data regarding physical properties, chemical composition including maximum allowable impurities, shrinkage, and casting temperatures should be ascertained by the laboratory and the particular items placed at the disposal of those to whom they are useful. Even the most technical designers sometimes are unfamiliar with the capabilities and limitations of the alloys they specify, especially the more recent developments such as aluminum bronzes and the light alloys. Also the patternmakers should be acquainted with the shrinkage allowances necessary for the standard alloys, so that excess allowance, which increases the machining costs, or insufficient allowances, which increases the percentage of rejections, may be avoided.

Crucible Cost Important

The cost of crucibles, when melting in crucible furnaces, always is an important item in the year's working. Therefore, comparison of different grades and different makes, and different methods of handling always leads to more economical procedure. It is a fairly widespread practice, to insure the co-operation of the furnaceman on this important point, to pay a bonus on all heats the crucible melts above a fixed number.

Both for record and comparison purposes and to avoid contamination, a crucible should melt only one alloy throughout its life. In Fig. 3 an index card is illustrated which is designed to keep the records necessary for both bonus and comparison purposes.

All deliveries of coke should be analyzed on receipt and the particulars recorded as in Fig. 5. The maximum sulphur and ash contents permissible should be ascertained with due regard to economy, and efforts made to insure supplies reaching or exceeding this standard of quality. The proper control of coke consumption always is a difficult matter, but with due care this can be controlled in common with other matters. The scheme adopted for effecting this control will vary with the nature of the particular foundry for which it is required. Total fuel consumptions over fairly long periods, say 3, 6, or 12 months, are, of course, easy to obtain. However, where close costing is needed, these figures are nearly valueless and the effect of changes in procedure, unless radical, are masked or extremely uncertain. What is wanted

REMELTED BORINGS	Grade 2 + 3	Ref. No 797	
Origin	D.S.P Machine Shop Turnings		
Weight	470 Lbs	Date 5-2-22 Percentage Loss	
After Magneting	452 Lbs	" 13-2-22	3.83
After Remelting	443 Lbs	" 16-2-22	1.97
Coke Consumption	168 Lbs	Percentage Wt. of Metal	37
To be used for	No. 2	Bins No.	13
Remarks	Percentage of iron Turnings Very Light also Probably Contaminated with Common Brass		
Storekeeper	J. E. Brown	Metallurgist	N.F. Rankine

FOUNDRY NO		Report for week ending		
1	Total metal melted	33.760	Percent	
2	Total castings made	27.242	Percentage of 1	80.66
3	Rejected in foundry	1033·35	Percentage of 2	3·79
4	Rejected in shops	1195·75	Percentage of 2	4·39
5	Net output	25012·9	Percentage of 2	91·82
6	Total coke consumption	12019	Percentage of 1	35·90

Metallurgist N.F. Rankine

ANALYSIS		Additions Per 100 lb. Used	Grade	Alloy
				2
Copper	87.62	Copper	+	14.5
Tin	11.34	Tin		
Lead	0.52	Lead		
Zinc	0.63	Zinc		
Phosphorus	0.263	Phosphor Copper	10%	1.0
Iron	0.24			
Nickel				
Aluminum				
Analyst	H.S. Thomas	Maximum Percentage to be used		25
Date	19/2/22			

ALLOY	Melted	Castings Made	Rejected Foundry	Rejected Shops	Net Output	Percentage Rejected
1	6370	5351	113	229	5009	6·40
2	11426	9598	272	479·5	8846·5	7·83
3	2304	2028	368	8	1983·2	2·21
5	9620	6926	383·25	299	6243·75	9·85
7	660	508	11·0	41·25	455·75	10·29
11	540	459	nil	20	439	4·36
15	2840	2372	217·3	119·0	2035·7	14·18

FIG. 6—INGOTS MADE FROM REMELTED BORINGS SHOULD BE ANALYZED AND THE RESULTS TABULATED ON A CARD
FIG. 7—WEEKLY REPORTS OF THE AMOUNT MELTED WITH THE PERCENTAGE OF LOSS GIVE AN IDEA OF HOW THE FOUNDRY IS OPERATING

is to be able to ascertain at any time the weight of coke being used to melt 100 pounds of any one of the standard alloys from day to day, or, at the least, from week to week. The writer does not propose to discuss the whole of the workable schemes which have been ,or could be, adpoted to secure this end but to quote one, which has been successfully used for the coke-fired furnaces in a large brass foundry

In this shop, each furnace has its separate coke bin situated in close proximity, and as the majority of the furnaces each are working on distinctive alloys the greater portion of the time this problem is simplified. The furnaceman obtains from the coke stock department, which, with its coke breaker also is an adjunct to the general stores, a supply calculated to be enough for a day's run. Where is is impracticable for the furnaceman to weigh every portion of the fuel used, a fairly close figure is obtained by averaging the day's consumption with the metal melted.

Temperature Control Essential

Throughout the foundry it is essential that all work such as core and mold drying, crucible annealing and, most of all, casting operations should be carefully controlled from a temperature basis. Where the expenditure is justifiable, all the core and mold ovens should be fitted with pyrometers connected to a recorder. One recorder, with suitable automatic devices, can be made to serve as many as six ovens, and the charts furnish interesting curves which can be used to institute decided improvements in working practice.

Every alloy, as already mentioned, should have its casting temperature limits determined with great care for different sections. The foundry should be provided with suitable thermocouples and indicators. It has been found in practice that after a short experience the intelligent workman can gage the temperature of any particular alloy with reasonable accuracy, excepting of course, alloys molten below 600 degrees Cent. When any new section or alloy is put into work, the pyrometer should be used as a check until the necessary experience has been gained.

Pass Through Stores

When the molds have been cast the resulting castings in whatever condition they may be, are passed to the cleaning department. The molders should not be permitted to abstract or hold back any defective castings, or remedy defects by burning, etc. The workmen in the cleaning department should pass visibly defective castings into the store department after sand-blasting. These castings, and also those rejected from the machine shops should be kept on one side and daily post-mortems held by the metallurgist and the foundry foreman before they are issued for remelting.

All patterns should bear a distinctive number indicating the alloy from which the castings are to be made so that the latter readily can be segregated according to the alloy of which it is composed. The cleaning room is provided with suitable trucks for each alloy for gates, risers, heads, etc., which are passed into the store room after each shift.

Tracing Trouble

When defects manifest themselves with any particular alloy or casting, systematized steps should be taken to cure them. Suggested remedies or alterations should be tried in succession and every mold stamped with a number indicating the day on which it was cast. One of the easiest ways of doing this is to call Jan. 1 No. 1 and Dec. 31, No. 365. Thus a mold cast on March 15 would bear the number 74. This number should be placed in a position where subsequent machining operations will not remove it, or, if this is impossible, the machine shop should be instructed to restamp after machining. Thus the wasters developing either in machining, on test, or service, can be traced back and the success or failure of the alterations in procedure determined. This method, besides being used for trouble curing, may be used for any alterations in practice, whether in design, raw material, melting, molding, or casting procedure, new alloys, etc.

Testing the Finished Product

All the alloys should be subjected to periodical physical and chemical tests, the frequency of the tests depending on the importance of the work. Test bars should be cast under ordinary routine conditions, always apart from the castings unless inspectors or specifications call for them to be attached. The results should be embodied on index cards similar to that shown in Fig. 4.

The correct method of handling scrap is always a vexed question in shops, and where a high standard of quality is to be maintained, many precautions are necessary and the whole-hearted co-operation of the machine shops essential. It is always an economical policy to pay the strictest attention in the machine shops to the careful segregation of the different turnings and borings. This should be insisted upon, and special metal-lined trucks provided for the use of the shops, with the name and number of the alloy clearly painted on them. If care is exercised in this way the borings and turnings often can be used without subsequently ingotting and analyzing them. However, in important work, it always is safer to adopt the latter course. This also is true of scrap of doubtful origin and composition.

After the ingots are analyzed the most suitable use can be determined, together with the additions required. These should be embodied on an index card similar to that shown in Fig. 6. This card can be used by the store department for the re-issue of the scrap.

The whole of the ash washing, magnetic separation, and metal recovery plant should be in charge of the general stores to insure the system being followed and weighing being done correctly.

By the adoption of systems similar to the one described it has been found that a great deal of detail work is taken off the shoulders of the foundry executives and metallurgist, while at the same time they are in constant touch with all the details. This enables them to devote their time to special problems and the more important executive work to the ultimate advantage of the company.

Making Heavy Machine Parts—II

(*Concluded from Page 225*)

heated and also goes to show that even in the most carefully planned work in the foundry some hither to unknown factor will introduce complications. The pipe arms were free to slide through the openings in the hub core and naturally it was expected that the contraction of the rim would drive the ends approximately ½-inch nearer the center. They were driven in as anticipated but while the lower set of arms remained in a normal position the upper set was cocked up on the hub end about ⅜-inch. Whatever force was responsible for this peculiar action, it was strong enough to split the hub core above the ends of the arms. Before this first hub was poured weights were applied to the arms and they were forced back into their proper position.

No plausible explanation was presented on why the upper arms should warp in this manner when heated on the outer ends. The molder in charge of the job set it down as one of these foundry mysteries to which there is no answer. In the meantime and pending a possible solution, he placed a big roll chill on the inner ends of the arms before he poured the second and subsequent drum rings and the arms stayed in their place.

Charles K. Wehm, formerly located at the Chicago office of the Blaw-Knox Co., has been transferred to the Pittsburgh office as district manager of the standard steel building department.

How and Why in Brass Founding

By Charles Vickers

Melting on a Forge

We desire to know if aluminum can be melted in an iron ladle over an open fire, such as a blacksmith's forge. Can gray iron ore brass be melted over a forge fire in a crucible, and what kind of a furnace is used when melting metal in a crucible? Kindly advise what kind of "dope" is mixed with sand before it can be used for molding, and if there are any books on melting practice and the construction of furnaces.

It is possible to melt aluminum in an iron ladle over a forge fire, but the ladle if made of wrought iron would not last long, and would probably be destroyed at the first melt. A cast iron vessel would be better than one of wrought iron. Cast iron, brass and bronze also can be melted over a forge fire, using a crucible as container. It is necessary to construct a furnace on top of the forge to confine the heat. Build up a square well on the forge, the inside diameter of which will be about 6 inches larger than the diameter of the crucible it is proposed to use and about 4 inches higher than the crucible as it stands in the furnace. The crucible must stand on a support about 4 inches high made by cutting off the bottom of another crucible, and putting it bottom upwards over the tuyere opening of the forge. To make outlet for the blast the support must be perforated with holes one inch diameter in two rings circling the stand. One ring should have the holes arranged above the vacant spaces in the second ring. Small pieces of coke must be used, the fire lighted and permitted to burn until the bricks are heated, all spaces on the outside being mudded up with a mixture of sand and clay. The top of the stand should be cleaned of coke, some fine charcoal put on and then the crucible is placed thereon. Coke is filled in until the furnace is filled to the top of the crucible. A cover should be put on top of the furnace to confine the heat, the crucible charged with metal and some charcoal and the fire urged until all is melted. It is necessary to make tongs to fit the crucible as the first operation. When the metal is molten, it can be removed by taking down the furnace. The tongs should be so shaped that upon embracing the crucible they form a long handle with which it can be carried. In the manner stated a crucible holding around 25 pounds of metal can be handled in a satisfactory manner.

No *dope* is used with molding sand, the latter being used as it comes from the beds. Molding sand can be obtained by the barrel from advertisers in THE FOUNDRY. We know of no books dealing with the construction of brass furnaces, and the melting of metals. It is not necessary to use homemade brass melting furnaces, as such furnaces can be bought ready made to suit the kind of fuel it is contemplated to use, whether oil, gas, coke or coal. The addresses of manufacturers of such appliances can be obtained from the advertising pages of THE FOUNDRY.

Using Aluminum Scrap

We occasionally purchase scrap aluminum for use in making metal patterns and recently have taken in a quantity of camp equipment, which, though apparently good aluminum, seems to contain some hardener. Can you suggest some manner of overcoming this condition in order the material can be mixed with the other aluminum and so be used?

The scrap aluminum can be used to excellent advantage provided its composition is known, as it could be cut down by adding new commercially pure aluminum, or it could be built up by the addition of further hardener. If the metal has been rolled or stamped it is not likely to contain anything that would make castings hard. It is likely the aluminum is too pure and the castings are so tough they are machined with difficulty. This condition the machinist frequently calls *hard*, and although it is difficult to machine, the metal in reality is not hard.

To alloy this material properly an analysis is necessary giving its composition. Without the analysis any attempt to alloy it is guess work with the chances favoring the expenditure of several times more money than an analysis would cost. An analysis will not cost more than $10, and ten dollars is quickly lost in doing experimental work in the foundry by those not trained to such work. Armed with the analysis we are in a position to advise how the scrap can be used to advantage, without it this is not possible.

Lathe Bearing Scores

We are sending for your inspection a small section cut from a bronze bearing which you will note is badly scored on the curved surface which forms the bearing. The steel shaft was 50 point carbon and the bearing holding it was well lubricated; the speed and lead were moderate, the same as used on all our turret lathe spindles, but this particular bearing failed to hold up, and constantly cut both itself and the spindle into grooves like the sample. This cutting action was so bad that after a week and a half the bearing was worn out and the spindle loose. We are unable to discover the reason for this action. The analysis of the bronze is copper, 80.96 per cent; tin 7.22 per cent; lead 8.19 per cent; zinc 3.11 per cent. Its scleroscope hardness is 17 and that of the spindle is 30. Our standard analysis for this bearing is 80-10-10 and this departs somewhat, especially in its content of zinc. The cutting action was not local in the bearing, but evenly distributed all over which leads us to think there is something at fault with the structure of the bronze that caused this peculiar action.

There is nothing in the analysis of the metal to cause such action as described, but we doubt if the analysis given is correct as we get on a qualitative test strong indication of the presence of considerable nickel. Also, the alloy has too much elongation to be a good bearing alloy. It would have to be fitted perfectly and lubricated perfectly to operate as a bearing without trouble. We incline to the belief the alloy contains hard crystals which score the bearing, but this view cannot be substantiated by analysis, only by making a microscopic examination of the metal. Microphotographs would throw light on the cause of its peculiar behavior and we suggest you have this done. Also have made microphotographs of bearings that give good service, accompanied by analyses of the metals which will form a valuable record of the cause of the difficulty.

An alloy containing 15 per cent lead minimum, with 7 per cent tin, remainder copper would be better for such bearings. The zinc does no harm. In fact up to 5 per cent with lead up to 22 per cent, tin at 5 per cent, and remainder copper, forms an excellent bearing alloy.

Acid Decomposes Cast Iron

Chemical and Physical Peculiarities Noted in a Casting Which Has Been Subjected to the Corrosive Influence of a Dilute Sulphuric Solution Covering a Long Period

ONE of the greatest problems of the age is that of arresting the oxidizing and the corrosive action upon metals and alloys which are in general use. After years of study and close observation science has been only partly successful in combating these destructive agencies which are ever present.

Cast iron and steel, in a broad sense apparently are more susceptible to these destructive agencies than the nonferrous metals. When a metal is attacked by oxidation or corrosive influences, a chemical and physical change is brought about, either in a mild or vigorous form in proportion to the power of the destructive forces acting upon the same. The time occupied by the change is the decomposition period and is that interval which elapses while the metal is being reduced into original elements, substances or parts. An example of an unusual state of decomposition in cast iron when subjected to the influences of a mild corrosive agency recently was noted by a representative of THE FOUNDRY.

Fig. 1 shows a part of one of two castings which formed a brace for the bottom of a 100-ton hydraulic press which was installed in the Huch Leather Co. plant in Chicago some 10 or 12 years ago. The press is used for squeezing the moisture from the hides after they are washed. To understand the corrosive action to which these castings were subjected, it is essential to know that one step in treating the hides is accomplished by the chemical action of lime. Lime, being alkaline adheres tenaciously to the hide fiber and cannot be removed readily by washing in plain water. Consequently mineral acids such as sulphuric, sulphurous and hydrochloric in dilute form are used for the deliming process. A dilute solution of sulphuric acid and salt generally is used for pickling which follows the deliming processes. The hides then are pressed, to remove surplus liquor.

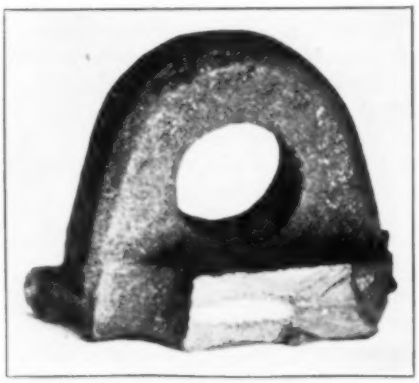


FIG. 1—CAST IRON LUG AS IT APPEARED AFTER 12 YEARS IMMERSION

Plausible Fairy Tales

LEGENDARY tales of cannon balls that for centuries had rested at the bottom of the sea state that the missiles on being brought to the surface and examined were found to be exceedingly light in weight. Further, it is said that their structure was so changed that they might be reduced to powder by the pressure of the hand.

These legends become plausible when considered in the light of the accompanying description of cast iron in the slow process of decomposition brought about by the action of feeble oxidizing and corrosive agencies. The chemical and physical results obtained, and conclusions drawn are offered by J. W. Bolton, chemical engineer, Niles Tool Works, Hamilton, O., to whom the sample was submitted for investigation.

The press in question had given excellent service covering a period of from 10 to 12 years, when one day the whole bottom of the machine dropped out allowing the hides to fall into the pit. The manager of the tannery, after examining the braces and noting how exceedingly light they were, believed that these braces had been made of wood instead of a strong metal. However, the manufacturers of the press were quick to realize that the chemicals squeezed from the hides in contact with and acting upon the castings for a long period eventually had sapped the strength of the metal. This, despite the fact that the size of the castings was not diminished in proportion to the loss in weight.

Fig. 2 shows the structure of a section 1 x 1 x ½ inch, cut from the original piece. The fracture bordering on the exterior shows a rusty, gray, crystalline appearance, merging into a fine-grained, hard, metallic brownish black at center. The portion shown at *A* is silvery gray in color, with a semimetalic luster, while that designated as *B* is brownish black with a marked metallic luster.

The exterior parts of the casting easily may be cut with a knife and are but faintly attracted by an ordinary, horseshoe magnet. The sample is extremely light, easily being mistaken by the casual observer for aluminum or magnesium which has been discolored.

A number of tests were made on the soft portion of the best piece to determine its chemical and physical properties. The chemical analysis showed an unusual condition. The results of the analysis follow:

	Per Cent
Silicon	9.50
Sulphur	0.96
Phosphorus	2.32
Manganese	0.88
Combined Carbon	2.86
Graphite	11.88
Total Carbon	14.74
Metallic Iron (figured as Fe)	34.5
Ferric Oxide (figured as Fe_2O_3)	77.0
Sulphur as sulphates	0.097
Chlorides	Trace

Determination of specific gravity showed 2.32 as compared with 7.2 for ordinary cast iron. The metallic portion was included in this determination so that the gravity of the soft portion is less than 2.32.

From consideration of the facts stated, it is evident that a large proportion of the original metallic iron

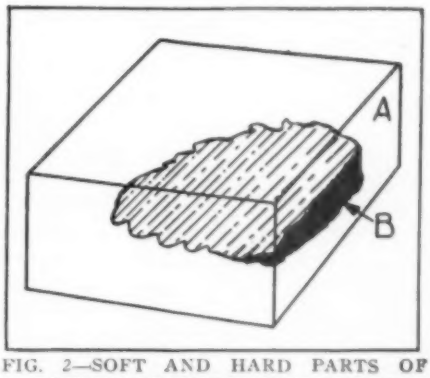


FIG. 2—SOFT AND HARD PARTS OF CASTING SHOWN RESPECTIVELY AT *A* AND *B*

has been supplemented by the much lighter iron oxide (Fe_2O_3). The graphite was not attacked and it would seem that the eutectic cementite, or combined carbon, was not as readily acted upon as the ferrite portion. The part containing the silicon probably left this silicon in the oxidized state as insoluble silica, (SiO_2). A portion of the manganese was carried away with the iron. It seems strange that the amount of sulphide sulphur is so high as one would expect the sulphuric acid to decompose the sulphides. The sulphate sulphur is low, the soluble sulphate formed evidently having been carried away by the liquid. Total iron is under 35 per cent, almost 66.66 per cent having been dissolved and carried away. Microscopic and other tests show that there is a great deal of Fe_2O_3 in the sample. Figuring all iron as Fe_2O_3, the total percentage of constituents only runs slightly over 100, bearing out this conclusion. Phosphides seem to have been but little affected.

Consideration of the gravity of the sample gives an idea of the composition of the original iron. The original iron was about 3½ times as heavy as the soft portion. Figuring back to get the original composition gives the following result:

	Per Cent
Silicon	2.70
Sulphur	0.27
Phosphorus	0.66
Manganese	?
Carbon (Total)	4.20

All these metalloids evidently are too high, possibly because the gravity of the *soft* portion is less than that used for calculations.

Examination with the microscope shows a dull portion, shown in Fig. 3, composed of graphite and iron oxide with a number of bright colored areas. A proportion of these latter contain steadite dendrites.

A number of conclusions might be drawn from these results. Many would be speculative. The following are offered in order of their probability.

First. Metallic iron and manganese were attacked and a considerable percentage removed from the casting. The remaining portion is largely oxide. Thus the ultimate action of this particular corrosion has been oxidation.

Second. Graphite was unattacked. On the other hand, the soft, open-flake structure of the graphite would allow the acid to act on a greater metal surface. The percentage of iron carbide carbon is higher than one would expect.

Third. Sulphides seem not to have been removed. The percentage of sulphate sulphur is lower than would be expected.

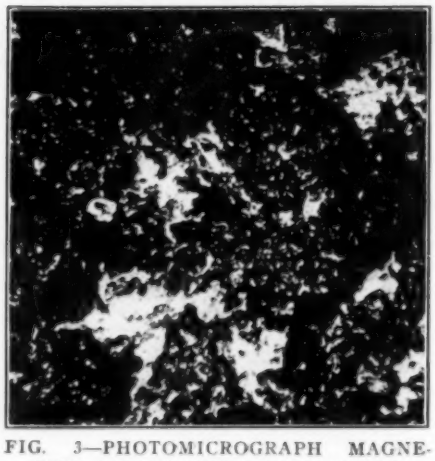


FIG. 3—PHOTOMICROGRAPH MAGNEFIED 100 DIAMETERS, POLISHED, BUT NOT ETCHED

Fourth. Phosphides seem little attacked. This conclusion is reached from a consideration of both analytical and microscopic examination. This phenomenon should be of great interest to pipe founders and makers of pump fittings and castings in general which are subjected to the corrosive action of mineral acid.

Trains Own Staff of Molders

(Concluded from Page 220)

erating expense. He also estimates that in the long run the expense incident to recruiting men in this manner is not so heavy and certainly does not exceed the expense incurred in the ordinary routine of labor turnover.

Each young man is coached carefully to a point where his day's remuneration if computed on a piece rate basis exceeds his daily wage. He then is considered and treated as a competent operator and his wage is computed from his daily output of good castings. He gradually increases his speed until he is on a par with any of the regular molders. Some men develop into competent and speedy operators in one or two weeks, while others do not arrive at a maximum for the same number of months.

The opinion of the instructor is accepted as final when a question arises as to whether a candidate is making satisfactory progress. For example, it has been found, contrary to a generally accepted belief, that men do not absorb instruction with equal facility on every job. The case of one young colored man is cited to illustrate an extreme instance. He was kept on one job for a week and made nothing but scrap. He then was given another pattern and did little better. The manager wanted to discharge him as a hopeless case, but the instructor, impressed by the apparent industry, eagerness and general intelligence of the young man, insisted on giving him further trial. After trying him on several patterns his faith eventually was justified. The young man developed an almost uncanny speed and skill on one particular job and his scrap loss over a period of six months did not exceed 2 per cent.

However, his case is regarded as rather exceptional. Usually a candidate who fails to create a favorable impression during the first week or two is dropped from the roll. This has happened only a few times during the period the plan has been in operation. The majority of the young men have appreciated the opportunity presented for increasing their earning capacity and have given the instructor the closest and most earnest cooperation.

Committee To Cooperate

The committee on heat treating of ferrous castings of the American Foundrymen's association is co-operating with committee A-4 of the American Society for Heat Treating and the work is being broadened to consider the heat treatment of gray iron and malleable castings. The American Foundrymen's association will be represented on the Steel Treaters subcommittee by the following men: Steel, R. A. Bull, 541 Diversity parkway, Chicago; Malleable, Enrique Touceda, Albany, N. Y.; gray iron, J. Fletcher Harper, Allis-Chalmers Co., Milwaukee. A meeting of the American Society for Steel Treating will be held in October in Pittsburgh, at which time plans for future work will be discussed.

To Take Advanced Work

Through an arrangement perfected by Scott Mackay, general superintendent, Stowell Co., South Milwaukee, Wis., with the dean of the graduate school at the University of Wisconsin, men actively engaged in the malleable industry in Milwaukee may take up and complete a post graduate course leading to advanced degrees. In the past, it has been necessary for men taking post graduate work to become residents at the university center. In this case under direction of Prof. McCaffery, department of metallurgy, instruction will be offered to a group of interested students at Milwaukee, professors being assigned from Madison to conduct these classes.

Bill Airs Views on Sash Weight Castings--I

BY PAT DWYER

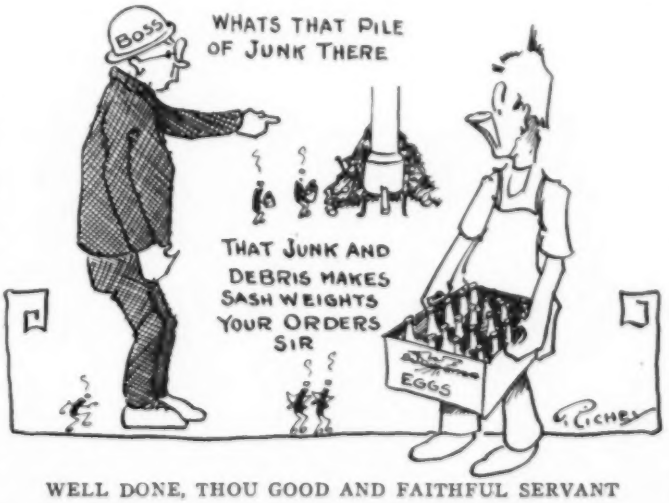
WHEN I called on Bill the other night I was informed by the lady who met me at the door that the man of the house was down in the cellar doing something to the furnace. This reference to a lady, of course, is an abject confession that I am hopelessly old fashioned and that I am lagging far behind the modern procession. I should have written *Mate*. All the newspapers use that expression, particularly in the weird and wonderful head lines. Mate Stabs Partner with Carving Knife. Mate Demands $1,000,000 Alimony. Mate Bumps Hubby with Flat Iron. Mate Uses Rat Poison. Mate Skewers Him with Poker. Mate Pulls Gat on Spouse.

You are familiar with all the gentle references which go to prove that chivalry and romance still are alive and vivid in this great republic and incidentally bear out the truth of the old saying: The course of true love never does run smooth. That last word of course should be smoothly, but have you ever heard of any person brave enough to make the change? Neither have I. Smooth it always has been and smooth it will remain. Considering the subject from one angle, I suppose this strong arm stuff is the logical outcome of the evolutionary process through which mankind has progressed since the beginning of time. At one period of the world's history when man was the lord of creation, he pranced lightly along the primrose bordered and amorous trail with a club in one hand and a hefty hunk of a granite bowlder in the other. A bashful swain who never could screw his courage to the sticking point of a formal proposal found an easy way out of the dilemma by tapping the lady lightly on the head with either the club or the rock and then dragging her away by the hair while she still was in an unconscious condition.

In these modern days the method would be considered a trifle crude, but the old way had its advantages. It saved time; it left no room for missunderstanding, and it relieved the lady of the embarrassment of making up her mind or the equally delicate task of choosing between rival suitors. No long drawn out courtships in those days. You will search in vain in any of the ancient chronicles for a counterpart of a novel of civilized life where the hero and heroine although madly in love with each other, circle around aimlessly, cross and recross each other's paths for 300 pages before they finally arrive at the grand clinch and fadeout.

One significant feature of the ancient lovemaking method seems to have escaped the attention of the eminent and long whiskered savants interested in prehistoric lore. This feature also indicates that human nature has not changed to any noticeable extent during the countless centuries in which this old earth has whirled through space. The gay boys and the swaggering Romeos were extremely prodigal in providing pictured evidence illustrating the manner in which they wooed and won the sprightly and presumably winsome damsels of those days. They were discreetly silent, dumb you might say, in leaving any record on their subsequent life or on how they pulled together while harnessed in a double yoke.

For want of evidence, naturally one is hampered in arriving at a definite conclusion, but I am inclined to the opinion that after the honeymoon, the ladies took a few private lessons in club swinging with maybe a supplementary lesson or two in the finer technique of heaving the rock. I think we reasonably may assume that this would be particularly true in the case where the gentleman with missdirected zeal had tapped the wrong lady on the head. He may have dragged her into his cave, but it is a safe bet that a few days thereafter she did up her hair, powdered her nose and emerged a cheerful and optimistic young widow. The coroner and undertaker arrived and helped close the episode. If she could and did get away with conduct of that kind at a time when she had no recognized rights or no legal standing, surely it is no sur-



WELL DONE, THOU GOOD AND FAITHFUL SERVANT

prise to find her following her own sweet will now that she has been granted equal rights with the other half of the universal vaudeville sketch. She keeps strictly up to date and instead of the unwieldy club and the equally cumbersome rock, she employs the more convenient and more highly efficient instrument symbolical of our exalted position in the scale of civilization.

However, all this really has no bearing on the question before the house and I stand properly rebuked for permitting my personal dislike for the word mate to lead me so far from the path on which I started so blithely.

If your memory is in ordinary or normal working trim you probably will recall (thank you) that Mrs. Bill told me her first assistant was in the cellar. She volunteered the further information that she did not know what he was doing, but judging by the alarming noise and by the shocking character of the strange words that floated up through the open registers she was afraid he was reducing the faithful old furnace to a pile of junk.

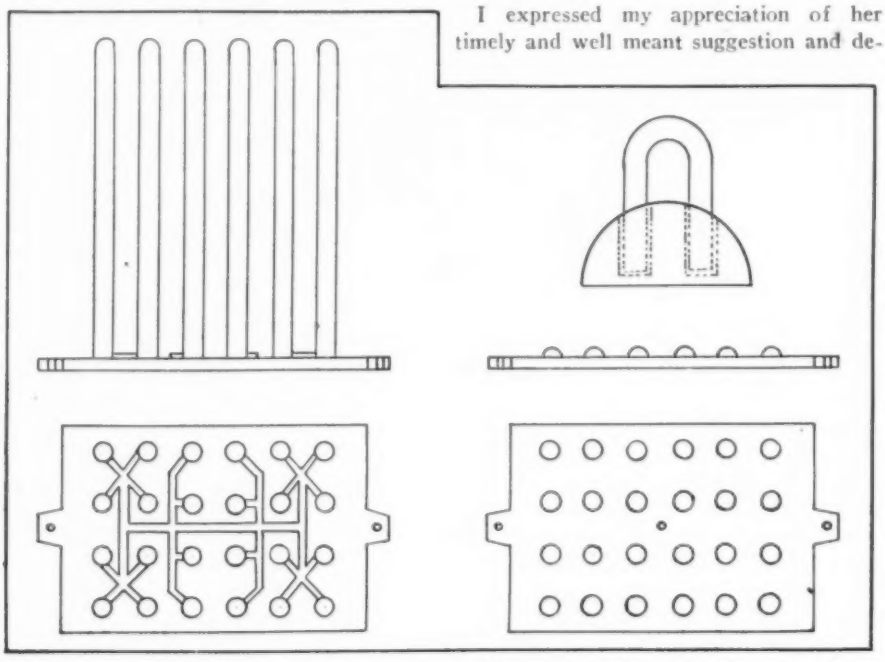
"Go down," said she, "and try to stop him. He will not pay any attention to me. If moral suasion fails, you will find an axe behind the stairs." This began to look like another one of those mate stories.

I expressed my appreciation of her timely and well meant suggestion and descended the stairs. Mrs. Bill closed the door at the head of the stairway and while I would not accuse her willingly or knowingly of any inhospitable act I imagined I heard a sound suspiciously like that caused by a key turning in a lock. Bill was standing in front of the furnace and from the wild expression in his eyes, I decided that Mrs. Bill had some reasonable ground for her suspicions.

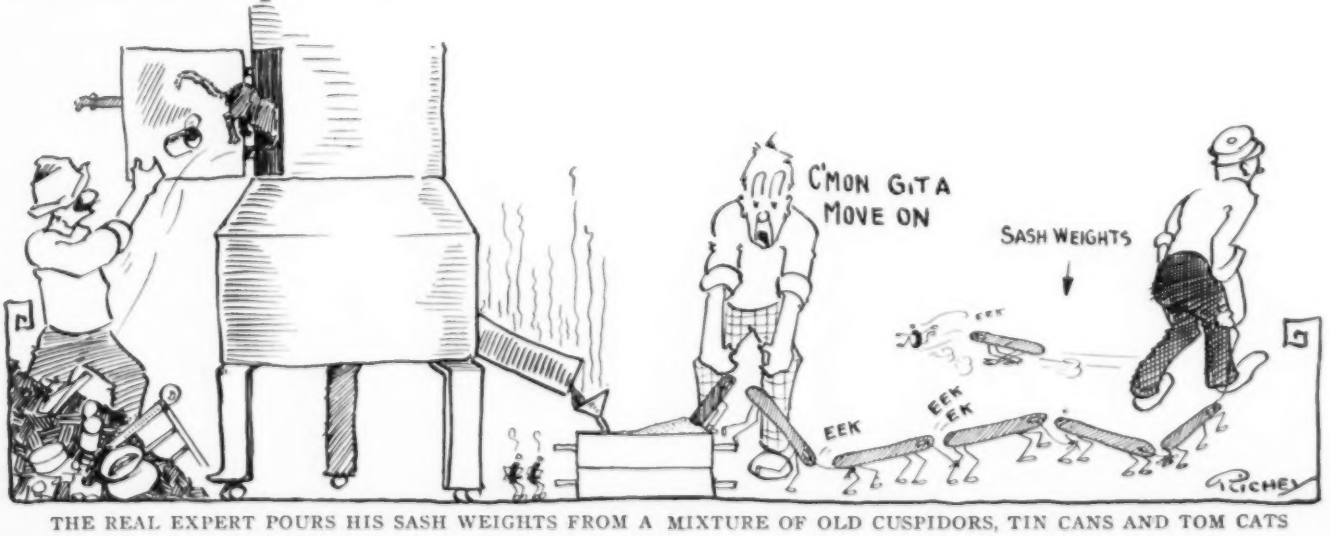
"You know me," said Bill, "a modest guy whose wants are few and simple. I am the lad the poet had in mind when he sang about man wants but little here below, nor wants that little long. I don't want much, but I am living in hope of having one wish gratified some day before I die, or before I lose my ambition and the necessary health and strength. I want to meet the architect, the builder, the landlord or whoever is responsible for placing a hot air furnace in a cellar with a 7-foot ceiling. The various pipes spring from the top and go squirming away like the arms of an octopus toward the various openings in the floor above. Each pipe is nearly a foot in diameter, usually they are suspended about a foot below the ceiling beams and the result is that any person above the stature of a dwarf either has to go around constantly bumping his head, or creeping around almost on all fours like a hurdy-gurdy monkey. I have given the subject a great deal of serious consideration and each time I bump my head I think up some new and fiendish form of torture which eventually I hope to have the pleasure of inflicting on the person responsible for placing the pipes where they are."

With a view to calming Bill's homicidal spirit I told him of a man who had visited me that day and who had described a clever method for making sashweight castings. This man mounted patterns of various lengths vertically on a board and rammed them in a deep drag. He rammed the cope on a second board provided with a number of knobs or buttons corresponding in position to the patterns on the first board. Each knob had two holes bored in it and before filling the cope with sand, the ends of a heavy wire loop were placed in the holes. The loops were designed to take the place of the eye usually formed in one end of the casting for the reception of the cord.

"Well," said Bill, "I'll tell you. There



PLAN AND ELEVATION OF PATTERN EQUIPMENT FOR DRAG AND COPE
UPPER RIGHT—DETAIL OF ONE CORE KNOB WITH WIRE LOOP IN PLACE



THE REAL EXPERT POURS HIS SASH WEIGHTS FROM A MIXTURE OF OLD CUSPIDORS, TIN CANS AND TOM CATS

are almost as many ways of making sashweights as there are advertised ways of going to heaven. Any one of the methods is satisfactory under certain conditions and by the same token under other conditions any one of the methods will land the traveler in—well—not in heaven.

"Practically every foundryman at one time or another in his career is bitten by the sashweight bug. In some cases the attack is mild. It soon wears off and usually the patient becomes immune to further attacks of the same character. Beyond a dent in his bank account, a sour taste in his mouth whenever an amateur colleague mentions sashweights, and a hard boiled, never-again attitude, the experience does him no harm. In fact later in life he extracts a certain amount of unholy joy when he learns of a competitor who falls a victim to the disease. The manufacture of sashweights is almost as highly specialized as any other branch of the foundry business and the amateur who expects to go up against this game and wrest great financial returns usually finds himself in the position of any amateur who ventures in among the professionals. He receives a medal occasionally and maybe honorable mention, but the professional gathers in the filthy lucre, the stuff that helps him slide calmly and gracefully from end to end of easy street. Usually the first symptom of the disease is a desire to find some profitable method of disposing of the surplus iron left over after the regular heat has been poured. The idea seems plausible. It bears every recognized mark of good judgment and sound business policy. Iron costs money to melt and unless the iron is turned into a marketable commodity, it is apparent that the money expended in melting it is wasted. The argument is good, sound and watertight and only has one fallacy, the cost of the casting exceeds the selling price and that one little feature is sufficient to knock the packing out of the most beautiful scheme that ever was invented or practiced either in the foundry or elsewhere.

"The extra cost accumulates through various channels. The flasks are put up at the back of the floor and perhaps one day out of six he has sufficient surplus iron to pour them all. On the other five days the greater number of the molds remain unpoured. This is one of the many deep and dark mysteries encountered in nearly every foundry. Under ordinary circumstances a sufficient quantity of iron is melted to pour all the molds on the floor. Usually a small quantity of iron is left over and is poured in the pig bed. Just so sure as a foundryman provides a few molds to absorb this extra iron, it disappears and he will have to drop the bottom even before all the regular molds are poured.

"The unpoured molds at the back of the floor are directly in the way when the molder starts to cut his sand over in the morning and, therefore, it is not surprising to find that he treats them with scant consideration. The gates get filled with sand, the clamps work loose, a yahoo bumps them with a wheelbarrow, some careless person lets a weight or an empty flask fall on them and when they eventually are poured the castings are missrun or shifted, the sand has dropped here and there or the iron runs out at the joint and either wholly or in part destroys the flask.

"The comparatively few good castings that are made are stocked and almost invariably when a customer is found he wants every size except the sizes on hand. A few doses of this famous extract of bitter root usually effects a complete and lasting cure. The cure is hastened in a gratifying manner when he quotes prices on some of his weights based on actual cost. The customer laughs and tells him he is no better than a robber. He can buy weights from the local representative of some national manufacturer at a lower price. In the case of other foundrymen the virus produces a different effect. They become obsessed with the idea that they can produce castings practically for nothing by melting the offscourings of the scrap market in the cupola. The simple faith of children is nothing in comparison with the innocent ignorance with which the uninitiated attempt to operate a cupola. A typical instance will serve to illustrate the point. J. Pluggem Quick returning on the Century Limited from the annual convention of the National Toreador association falls into conversation with an important young captain of industry who informs him lanquidly that he is the second assistant purchasing agent for the Excelsior Foundry & Machine Co., Goose Pond, Ky. By a few adroit questions our hero leads the conversation up to the subject of sashweights and learns to his amazement that the Excelsior people would not dream of melting either pig iron or machine scrap for their sashweight castings. They charge the cupola with tin plate clippings, borings and rubbish gathered up in the yard.

"At this point any practical man would beg for further detail on the construction of the cupola, tuyere arrangement, method of slagging and other important features involved in operating a cupola under extraordinary conditions. If he did he probably would discover that the second assistant purchasing agent never put his patent leather shoes on the charging platform. Off hand he could not say whether the iron is tapped through a hole in the side, a hole in the bottom or is dipped out through the top in an old oaken bucket.

"J. Pluggem is not a practical man. He enters his own shop the following

FAKED FOUNDRY FACTS

A VIBRATOR

day and despite the protests of foreman and melter who know the limitations of their own cupola, he orders a miscellaneous mess of junk thrown into it which would give the devil himself indigestion. The cupola becomes bunged up and after our hero figures the loss including the time required to clear away the mess he loses interest in the sashweight business.

"Rubbish and miscellaneous dirty scrap can be melted, but the cupola has to be equipped with high tuyeres, an excess amount of fluxing material must be employed and the extra volume of slag must be drawn off readily and constantly. The process presents many features not encountered where clean pig and scrap are melted in the ordinary small cupola, where the tuyeres are low and where no slag hole is required for the melting of comparatively small heats."

"It seems to me," I said, "that we have drifted a long way from heating furnaces and the men who build them."

Bill grinned and I knew that once more all was well with the world and the inhabitants thereof including furnaces and furnace builders.

"Talking about furnaces," said he, "have I ever told you the story of the gallant young army officer who was sent to inspect the Angelina stack in—let us say—Kokomo. It is one of the charming little episodes connected with the late war; one of the almost inexhaustible list of things doled out at intervals over a period of five years to a long suffering public under the general heading: Now it may be told.

"The government contemplated taking over a blast furnace and the young officer who a few months before had been a rising young hay, grain, flour and feed merchant on the banks of the Wabash, was sent to inspect the property. He was met at the station by the president and other prominent officials of the blast furnace company who were quite willing to do all in their power to aid the government—for a reasonable consideration. The party proceeded by automobile and finally arrived at a point where the stack and the hot blast stoves were visible in the distance. The president directed the officer's gaze in the proper direction and said 'Captain, yonder's the furnace.' Our hero came to instant attention and in what he doubtless considered the free and easy conversational tone of one old hardened cinder snapper to another, he said, 'Ah! Yes, of course, I see her now. Tell me —I had overlooked the point until this present moment—Is she a hot air or a hot water furnace?' "

Oven Stoker Handles Bituminous Coal

BY JAMES W. ARMOUR

OFTEN many small items of cost are overlooked in the foundry while the larger expenditures are scrutinized closely One item on which daily savings may be made is the cost of providing heat for the core ovens. A few foundries have made a study of this problem and now are benefitted by a daily saving, which in the course of a year amounts to a substantial sum.

Many foundries burn coke to bake cores. Coke burns without much smoke, requires little attention, is obtained easily and has proved a satisfactory fuel for core oven furnaces. However, combustion engineers have been studying the problem of using other heat elements for core ovens, with the result that oil, gas, electricity, powdered coal and ordinary bituminous coal are utilized.

In the Detroit plant of the Sanford Riley Stoker Co. a stoker of the company's own design has been installed on the core ovens. This stoker burns bituminous coal of the same grade as that used in the power house. The application of the stoker to the core ovens, and the finished installation, are shown in the accompanying illustrations.

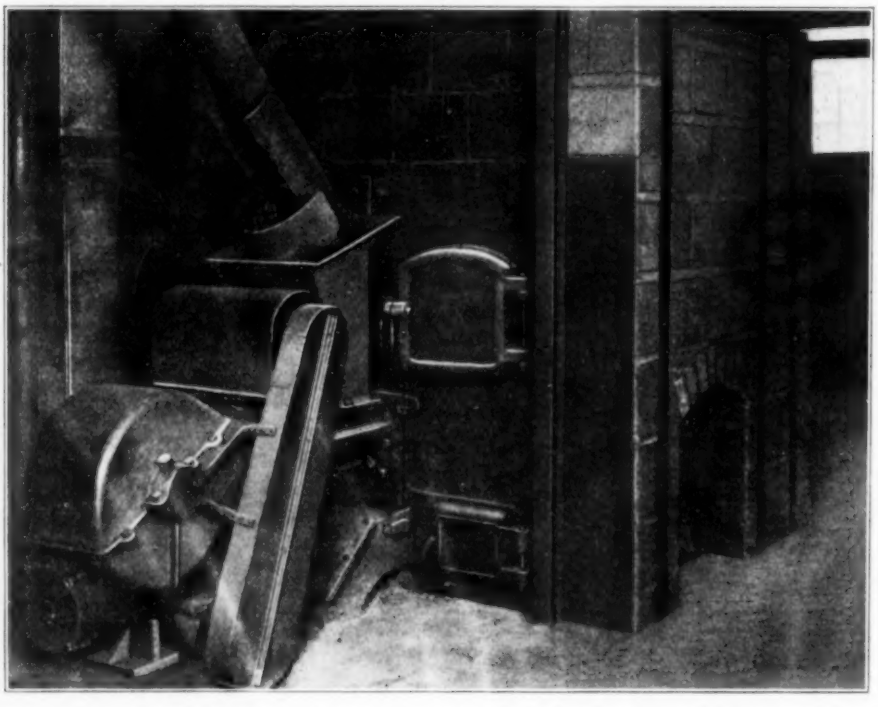


FIG. 1—UNDERFEED TYPE STOKER INSTALLED IN CORE OVEN—BITUMINOUS COAL IS RECEIVED FROM STORAGE ABOVE

The stoker is the underfeed type, coal being forced into the furnace by a reciprocating ram which is operated by a crank and driven by a worm gear reducing mechanism. Power is supplied by a small motor mounted above the ram case and connected with a reducing gear drive by a silent chain. The green coal is fed underneath the hot fuel bed so that the gases from the coal are distilled and burned as they pass through the hot part of the fire. Forced draft is used with this stoker, air being supplied by the same fan that formerly was used with the hand-fired grates.

As this installation was more or less experimental, it was thought best not to replace the hand-fired grates with the stoker, but to make the installation such that if the stoker did not prove satisfactory it would be a simple matter to return to hand firing. This was done by making another opening in the flue and building a special furnace for the stoker. The flue connecting the hand-fired furnace to the stack was closed. At the time the stoker was installed the foundry was working at almost maximum capacity and a shut down of the core oven would have been a great han-

dicap. However, the operation of the stoker has been satisfactory and it has not been necessary to return to hand firing with coke.

Although the requirements of the Sanford Riley Stoker Co. do not necessitate continuous operation of the core ovens, the stoker, nevertheless, is adapted to this purpose. Since the green fuel is fed under the live fuel bed, the temperature of the furnace does not drop when more fuel is supplied, as in the case of hand firing where the fuel is thrown on top of the live coals. An even temperature can be obtained throughout long periods of operations, if this is desired.

The stoker was installed and put in operation in May, 1923, and has been in constant use since that time, supplying heat for three core ovens. When it first was installed no provision was made for storing any great quantity of coal near the stoker, one man being required to truck the coal from the power house storage pile which was a considerable distance away. This disadvantage since has been overcome by arranging a coal storage hopper over the stoker as shown in *C*, Fig. 2. This hopper is filled by the grab bucket of the yard crane. A chute, *B*, Fig. 2, conveys the coal from the storage hopper to the stoker hopper. The stoker installed in the furnace is shown in Fig. 1 and *A*, Fig. 2.

No accurate data are obtainable on the cost of the hand-fired operation, but general figures show that the weight of coal per pound of sand used in the core room is approximately the same as the weight of coke per pound of sand formerly used. This condition will vary depending on the number of hours that the stoker is operated, the size and shape of the cores and the heat value of the coke used. In another foundry, where a stoker of the same type was installed, a comparison was made with a similar furnace using oil as fuel. Here it was found that about 10 pounds of coal was used to bake the same amount of cores as one gallon of fuel oil. Any saving that may be found in using the stoker with bituminous coal depends almost entirely on the cost of the various types of fuels.

The National Machine & Iron Works, Inc., 1520 Conti St., New Orleans, La., has leased equipment and will start operating a foundry, making brass goods, with particular attention to marine repair work, saw mill, sugar mill, rice mill and ice house requirements.

Warren Company To Make Engine Pistons

The Warren Foundry Co., Warren, O., has been incorporated with $250,000 capital to operate a continuous foundry, making gray iron automobile engine pistons. This company has taken over the plant and real estate previously occupied by the Warren Metallic Bed Co. and equipment to be purchased and installed will include two cupolas, with special molding and conveying machinery necessary to provide a capacity of 10,000 tons of castings a year.

The officers of the new company are F. B. Whitlock, president and treasurer, E. W. Beach, vice president and manager and E. T. Ward, secretary. Mr. Whitlock has been president and manager of the Interstate Foundry Co., Cleveland, for the past eight years and previous to that time was connected with the National Malleable Castings Co. at its Chicago plant. His experience has been largely in the automotive branch of the foundry industry and he is widely known as an executive.

Mr. Beach, from 1919 until 1923 was president and manager of the Ferro Machine & Foundry Co., Cleveland. He accepted this position following his work with the air service production division during the war, where his previous experience as vice president and manager of the Manufacturers Foundry Co., Waterbury, Conn., fitted him for the demands of high speed production. At present, Mr. Beach is a director of the American Foundrymen's association.

Edwin T. Ward, who is secretary of the new organization, formerly was connected with the General Malleable Castings Co., Warren.

The company plans to employ about 100 men and expects to start operations by June 1.

Plan Joint Safety Meeting

The engineering section of the National Safety council will join with the Cleveland Safety council, the Society of Ohio Safety Engineers, and the Cleveland Engineering society May 16 in a comprehensive safety conference in Cleveland. The general topics to be discussed by prominent men are "Safety Legislation and Codes" and "Plant Housekeeping." The speakers will be J. W. Patterson, Hydraulic Pressed Steel Co., Cleveland; Dr. H. C. Davis; J. M. Woltz, Youngstown Sheet & Tube Co., Youngstown, O.; F. C. Allen, New York and F. A. Scott, who will act as chairman at an informal dinner in the evening.

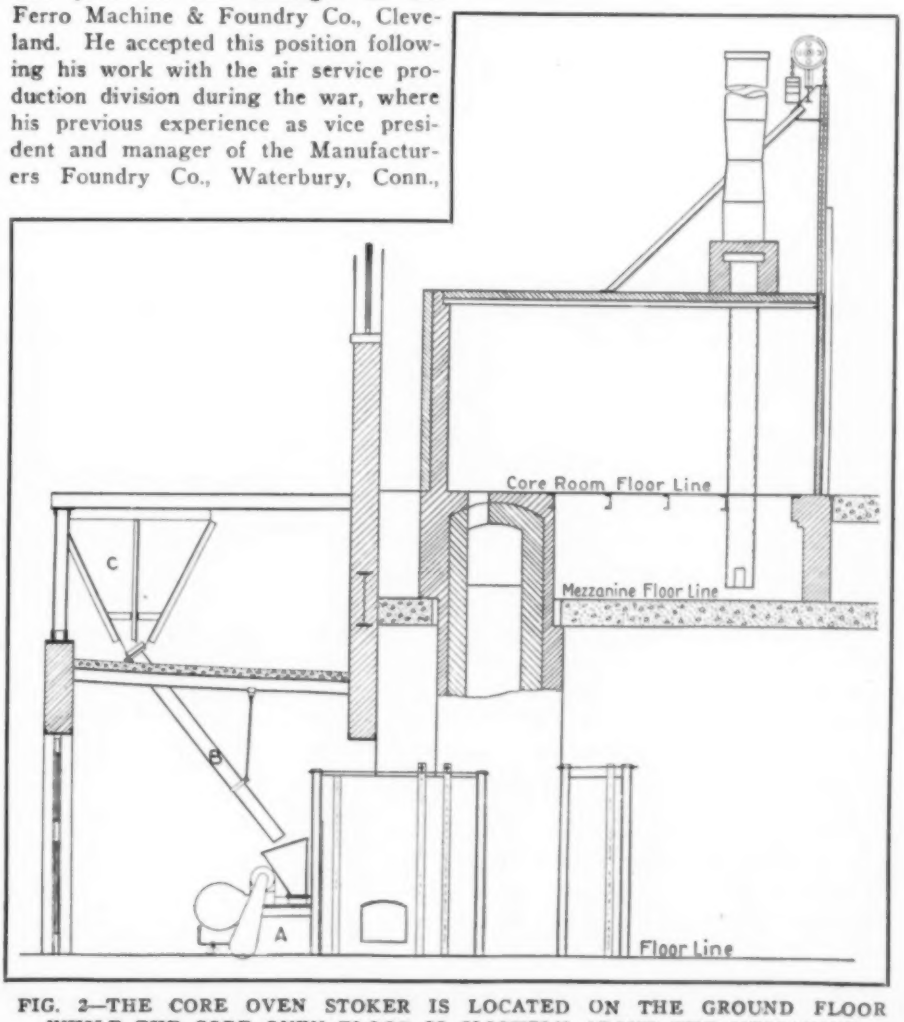


FIG. 2—THE CORE OVEN STOKER IS LOCATED ON THE GROUND FLOOR WHILE THE CORE OVEN FLOOR IS SLIGHTLY ABOVE THE MEZZANINE

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What Are Molders Worth?

ARE the earnings of foundry workers too low in comparison with those in other lines of endeavor This question intrudes whenever the problem of increasing production is encountered in periods of industrial activity. A favorite form of comparison which is recurrent every spring in the centers where building construction is active is decidedly to the prejudice of foundry wage rates. Prevailing molders hourly payments are placed alongside the flowery premiums being paid to plasterers, plumbers and bricklayers and the result, even when unsupported by a comparison of the physical attractiveness of the different lines of employment, is far from favorable to the molders' scale.

In the majority of instances, the seasonal and irregular employment offered by the building trades is overlooked. True, the worker himself disregards this factor and the result is a procession out of the foundries and into the contractor's employment offices during the months when outside construction work is plentiful.

In a report recently issued by the government bureau of labor statistics, some interesting comments are offered in comparing the wages and hours of employment in foundries and machine shops. The data were gathered directly from pay roll records in 351 representative foundries and 429 machine shops in 28 states ranging from Alabama to Maine and New York to Oregon. The states investigated embrace 97 per cent of the wage earners in the industries studied. This study was made during the period from February to April, 1923.

A commentary is furnished showing that the number of days employment offered in the foundries ranged from 50 to 312 for the year ending Dec. 31, 1922, the average being 291 days. The machine shops averaged 300 days for a like period. Among the foundries, 98 establishments were closed from 2 to 257 days due to lack of orders. In the same time 51 machine shops were closed for a like elapsed time for the same causes.

A detailed study of the earnings in the foundries visited, may be made from the accompanying tabulation. It will be noted that the average weekly earnings in the foundries was $29.29 for men and $19.92 for women, while the average earnings per hour were $0.559 and $0.404 respectively. The table follows:

EMPLOYMENT AND EARNINGS IN FOUNDRIES

Occupation and sex	No. of establishments	No. of employes	Average full-time hours per week	Average earnings per hour	Average full-time earnings per week
Chippers and rough grinders, male	319	2,923	52.5	$0.465	$24.41
Coremakers, male	345	2,526	51.4	0.690	35.47
Coremakers, female	22	240	49.2	0.431	21.21
Crane operators, male	197	593	53.5	0.522	27.93
Cupola tenders, male	342	556	52.4	0.546	28.61
Laborers, male	343	9,265	53.5	0.428	22.90
Laborers, female	8	68	49.4	0.316	15.61
Molders, hand, bench, male	262	2,379	51.3	0.687	35.24
Molders, hand, floor, male	346	4,904	51.2	0.729	37.32
Molders, machine, male	161	1,993	51.9	0.678	35.19
Molders' helpers, floor, male	234	1,986	52.2	0.433	22.60
Patternmakers, male	283	1,314	51.1	0.751	38.38
Rough carpenters, male	261	680	52.0	0.534	27.77
Other foundry employes, male	304	2,737	53.6	0.503	26.96
Other foundry employes, female	2	2	51.0	0.213	10.86
All occupations, male	351	31,856	52.4	0.559	29.29
All occupations, female	22	310	49.3	0.404	19.92

In the machine shops, the average weekly earnings are given as $28.24 for men and $17.97 for women, while the hourly rates were $0.556 and $0.366. The average number of full time hours per week for men in machine shops is given as 50.8, while the foundries average 52.4 hours.

Trade Outlook in the Foundry Industry

WERE it possible to plot a curve showing accurately the volume of business booked by foundries throughout the country, a slight but decided upward trend would be noted. While no exceptional development has been observed since the first of the year, the general situation has improved, inquiries are satisfactory and orders are forthcoming in a volume in excess of present production. A feature of interest is the drift of castings business to smaller communities and away from the large cities where operating costs are higher. The difference in many cases outweighs the freight tariffs on shipments of castings up to 50 or 75 miles.

Business Is Sound

Despite political clamor and the Presidential year bogey, business is undisturbed. The demand for manufactured articles paces ahead of output in practically every line. According to the department of commerce, a revised, weighted index of 65 commodities based on 1919 as 100, shows 117 for January against 104 for December, 1923, as the measure of manufacturing production. Another important scale by which to judge the state of business is the official figure for freight car loadings. During the month of February an increase of 8 per cent was registered over the weekly totals for the same period last year. For the present year, freight movements have surpassed the previously unexcelled winter totals in 1923 by nearly 4 per cent. While a slight decline was noted in the last week of February, when compared with the previous week, the figure given, 845,898 cars, exceeds the loadings for any corresponding week in the past four years. The increased demand upon the carriers forms a sound basis for the faith in more car and locomotive requirements.

Awards Are Heavy

The total number of freight car orders placed in February is given as 42,421. This almost equals the figure of 42,479, placed in March 1923, which was the record month for the past several years. Further, at the close of the month, inquiries for more than 20,000 freight cars were before Chicago car builders. Railway specialty shops share with the automotive foundries in the anticipation of heavy buying of their products as the year advances. The total revised output of automobiles of all classes for 1923, as reported by the department of commerce is 4,011,873 as against 2,586,049 for 1922. As is customary, opinion is divided as to the requirements for 1924. The automobile industry has discredited more prophets than any other single line of endeavor. One large manufacturer of a medium price car confidently states that 1924 will see an output of over five million vehicles and the only limiting factor will be the ability of dealers to dispose of used cars taken in trade. Preliminary reports placed the February production at 349,000, a gain of 26 per cent over the same month last year. Sales and production schedules in many makes of cars are highly satisfactory.

Iron Is Quiet

Furnace and radiator interests, and makers of sanitary ware have been buying iron in fair volume, but generally the demand is light. February's production according to statistics compiled by the *Iron Trade Review* showed a gain. The total output of pig iron for the past month was 3,064,536 tons, compared with 3,015,480 tons for the first month of the year. On a daily average basis, February showed a rate of 105,673 tons per day, a gain of 8400 tons over the average of 97,273 tons for January. This is an increase of 8.64 per cent. On the same basis of comparison, February showed 23,662 tons of merchant iron, against 22,829 tons daily average production of the same class of iron for the preceding month. This gives an increase of 793 tons per day. The total number of blast furnaces active increased from 248 on Jan. 31 to 262 on Feb. 29. Demand for cast-iron pipe for municipal needs is increasing. Farm implement requirements are advancing with foreign exports of implements in January, 1924 three times those noted in the same month last year and twice as great as the total for January, 1922. Building activity is pronounced and this winter has been exceptional in this regard. January production of malleable castings according to the department of commerce totaled 64,379 tons for 127 plants. This shows operations to be at 58.6 per cent of capacity for that month. The same plants booked orders for 73,964 tons or 67 per cent of the total capacity reporting. Heavy jobbing foundries report varied fortunes, but in general this class of work is scarce. Light gray iron shops are fairly busy, particularly through New England. Stove plate and furnace foundries are slackening as the season advances.

Prices for Raw Materials for Foundry Use

CORRECTED TO FEB. 8

Iron		Scrap	
No. 2 Foundry, Valley	$26.00 to 27.00	Heavy melting steel, Valley	$20.00 to 20.50
No. 2 Southern, Birmingham	23.50 to 24.00	Heavy melting steel, Pitts.	20.00 to 20.50
No. 2 Foundry, Chicago	24.50	Heavy melting steel, Chicago	17.50 to 18.00
No. 2 Foundry, Philadelphia	23.76	Stove plate, Chicago	19.00 to 19.50
No. 2 Foundry, Buffalo	22.00	No. 1 cast, Chicago	22.50 to 23.00
Basic, Valley	22.00	No. 1 cast, Philadelphia	19.50 to 20.50
Basic, Buffalo	23.00	No. 1 cast, Birmingham	19.50 to 20.00
Malleable, Chicago	24.50	No. 1 cast, Buffalo	20.00 to 20.50
Malleable, Buffalo	22.00	Car wheels, iron, Pittsburgh	20.00 to 21.00
		Car wheels, iron, Chicago	20.50 to 21.00
Coke		Railroad malleable, Chicago	21.00 to 21.50
Connellsville foundry, coke	5.00 to 5.75	Agricultural mal., Chicago	19.50 to 20.50
Wise County foundry, coke	5.00 to 6.50	Malleable, Buffalo	20.50 to 21.00

Brass Shops Active

Nonferrous foundries are exceptionally fortunate. Their rate of operation in general is ahead of the gray iron shops. Plumbing goods foundries in particular are busy, while automotive requirements play a strong part in bringing new business to brass and aluminum foundries. Prices on nonferrous metals, according to New York quotations in the *Daily Metal Trade* of March 8, follow: Casting copper, 13.62½c; electrolytic copper, 14.00c; Straits tin, 56.50c to 56.62½c; lead, 9.62½c; antimony, 11.50c; electrolytic nickel, 32.00c; aluminum, No. 12 alloy, remelt, 23.50c to 24.00c. Zinc is 6.62½c, E. St. Louis, Ill. Average daily prices for February follow:

Castings Copper	Electrolytic Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
12.779	13.013	9.214	53.453	10.802	27.00	6.774

Comings and Goings of Foundrymen

HORACE W. GILLETT for the past 10 years chief alloy chemist in charge of the Ithaca, N. Y. office, metallurgical division, bureau of mines, has been appointed chief of the metallurgical division of the bureau of standards, Washington by Herbert Hoover, secretary of commerce. The appointment is effective as of March 1, and fills the vacancy recently created when Dr. G. K. Burgess became director of the bureau of standards.

Dr. Gillett holds A. B. and Ph. D. degrees from Cornell university where

HORACE W. GILLETT

he specialized on electric furnaces in graduate work and later acted as assistant instructor in the chemistry department. He afterward engaged in geneneral chemical work in the laboratories of Thomas A. Edison, West Orange, N. J., and A. D. Little, Boston. In 1910 he started the research department of the Aluminum Castings Co., Detroit where he remained for three years He is widely known in the metallurgical industry through his invention of the rocking electric brass melting furnace and through a number of published works on chemical and metallurgical subjects. These include *Temperature Measurements in an Experimental Carborundum Furnace, Brass Furnace Practice in the United States, Melting Aluminum Chips, and Melting Brass in a Rocking Electric Furnace.* In addition to articles in other scientific journals he is the author of a comprehensive series of 13 articles entitled *Electrical Melting of Alloys* which was published serially in THE FOUNDRY from March 1 to Sept. 1, 1920. During the war Dr. Gillett was engaged in co-operative metallurgical and electric furnace work in connection with problems of the war industries board. He is one of the vice presidents of the Electro-Chemical society, a member of the American Chemical society, British Institute of Metals and other scientific organizations.

J. H. Hopp, Charles C. Kawin Co., Chicago, will be the speaker at the meeting of the Quad Cities Foundrymen's club, March 17.

Thomas Wright, formerly connected with the Watertown arsenal, Watertown, Mass., has been made assistant foreman for the United States Engineering & Foundry Co., Vandergrift, Pa.

Paul F. Hermann, formerly one of the managers of *Stahl und Eisen*, German technical publication, has opened offices at 501 Century building, Pittsburgh, as a representative of foreign publishing and scientific societies.

J. H. Danver formerly a member of the firm of the Molding Device Co., Zelienople, Pa., and previous to that time in charge of different foundries has accepted a sales position with the Berkshire Mfg. Co., Cleveland.

E. E. Linthicum, president of the National Cast Iron Pipe Co., Birmingham, Ala., who is making a survey of business conditions on the Pacific coast, has returned to San Francisco from a short trip to Honolulu.

E. T. Runge, Cleveland, addressed the members of the Quad City Foundrymen's association at the February meeting held in Moline, Ill. Mr. Runge discussed foundry costs in the light of his experience as cost advisor to the Ohio State Foundrymen's association.

Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, addressed the members of the Pittsburgh Foundrymen's association on the occasion of its regular monthly meeting held at the General Forbes hotel, Monday evening, Feb. 18 on the subject, "Scientific Research for Industry." Dr. Weidlein dwelt at length on the many developments of the past year in related industries with the application of these developments to the foundry. John W. Guay, president of the society, presided.

Gustave Paul Masson, who was recently elected president of the Association Technique de Fonderie de Liege, Belgium, otherwise the Belgium Foundrymen's association, is one of the most prominent among the younger generation of foundry engineers and managers in King Albert's domain. He was educated as an engineer at the University of Liege, graduating in 1912, after which he

GUSTAVE PAUL MASSON

entered the foundry of A. Ketin at Sclessin. He has been a member of the Belgian Foundrymen's association since 1913 and was successively a director and treasurer. He served throughout the war in the Belgian army, receiving the Croix de Guerre and the special medal for the defense of Liege in 1914. Since 1922 he has been director of the Fonderies de Chenee, making cast rolls at Chenee near Liege.

Edwin K. Smith has been made research engineer for the Stockham Pipe & Fittings Co., Birmingham, Ala. For the past several years Mr. Smith has been metallurgist and later superintendent for the Wisconsin Malleable Iron Co., Milwaukee.

Southern Metal Trades Association Meets

The seventh annual convention of the Southern Metal Trades association was held in the St. Charles hotel, New Orleans Feb. 26-27. The two-day session was devoted to a consideration of industrial and educational problems. On the first day E. S. Jouett, vice president and legal counsel of the Louisville & Nashville railroad gave an address entitled "Tinkering with the Transportation Act." The closing paper of the day was delivered by Enrique Touceda, Albany, N. Y. N. M. Leach, president, the Pacific-Caribbean Gulf Steamship Line, spoke at the annual banquet on "The Port of New Orleans." Addresses by Thomas Perkins, cost accountant, and H. M. Lane, consulting engineer, were on the program of the second day.

The following officers were elected: President, E. F. Billington, Soule Steam Feed Works, Meridian, Miss.; first vice president, W. O. Trout, Lufkin Foundry & Machine Co., Lufkin, Tex.; treasurer, J. M. Hollowell, Spalding Foundry Co., Atlanta, Ga.; secretary, W. E. Dunn Jr., Atlanta, Ga. The following were elected vice presidents representing every state in which the association has members: W. E. Thomas, Union Foundry Co., Danville, Va.; George B. Crocker, Crocker Machine & Foundry Co., Gastonia, N. C.; T. H. Siddall, Sumter Machinery Co., Sumter, S. C.; John S. Schofield, Schofield's Sons Co., Macon, Ga.; R. O. Collins, Tallahassee Iron Works, Tallahassee, Fla.; E. W. McDonald, Talladega Foundry & Machine Co., Talladega, Ala.; J. A. Mosal, Mississippi Foundry & Machine Co., Jackson, Miss.; Charles R. Law, De Sota Foundry & Machine Co., Mansfield, La.; George C. Holmgreen, Adams Iron Works, San Antonio, Tex.; F. I. Brown, Arkansas Foundry Co., Little Rock, Ark.; and T. M. Lamalta, Chelasan Machine & Foundry Co., Memphis, Tenn.

Purchase German Rights to Die Process

The German rights for the manufacture of die castings under the patents held by the Doehler Die Casting Co., Brooklyn, N. Y., have been purchased by a syndicate composed of Hugo Stinnes and Hirch, Kupfer & Messingwerke. Construction of the building for making die castings already has been begun in Hamburg, and it is expected that the business will be operated as the Doehler Giess machine, G. M. B. H. The final details of the transaction which has been under negotiation for some time were arranged during the recent visit to this country of Mr. Stinnes' son. The transaction also gives Mr. Stinnes the right to sublet the Doehler process in other European or South American countries.

C. A. Collins Is Dead

C. A. Collins, Milwaukee manager for the Federal Foundry Supply Co., Cleveland, died Feb. 26, aged 34 years. Mr. Collins spent practically his entire business life with the same firm, having accepted a position in the accounting department at Cleveland 13 years ago. His qualifications were such that he was given opportunity to enter the sales department and for a number of years he traveled out of the Milwaukee office. His territory covered Illinois, Iowa, Wisconsin and Minnesota.

C. A. COLLINS

At the beginning of the World war Mr. Collins enlisted in the navy, serving with the crew of the U. S. S. DOROTHEA and afterward being transferred as first-class yeoman to the VON STEUBEN to serve continuously until after the armistice.

On his return to the Federal company he was made branch manager at Milwaukee, a position which he held until the time of his death.

The name of the Academy Shops Mfg. Co. has been changed to Carolina Iron Works, Inc., Mooresville, N. C. The business of this company formerly was conducted as a trade school and while this feature will be continued so far as apprenticeships are concerned, the main business will be the manufacture of iron and steel products and general repairs. J. O. Johnston is president of the company.

Publish Digest of Cost Association Activity

The National Association of Cost Accountants, 130 W. Forty-second St., New York, has published its year book for 1923 with the proceedings of the fourth international cost conference. The first portion covers the convention held at Buffalo, September, 1923, gives an account of the business and social activities of the association and the names of the officers elected for the year 1924. Methods of wage payments as related to costs, with introductory remarks and discussions, examples of advantageous uses of operating budgets, and the basis upon which raw materials should be charged into production costs are covered at length. Centralization of detail cost work in the head office, and the relation of planning and dispatching to cost accounting form topics for material presented, and a section of the book deals with the important question of how far it is proper for a trade association to distribute cost information among its members.

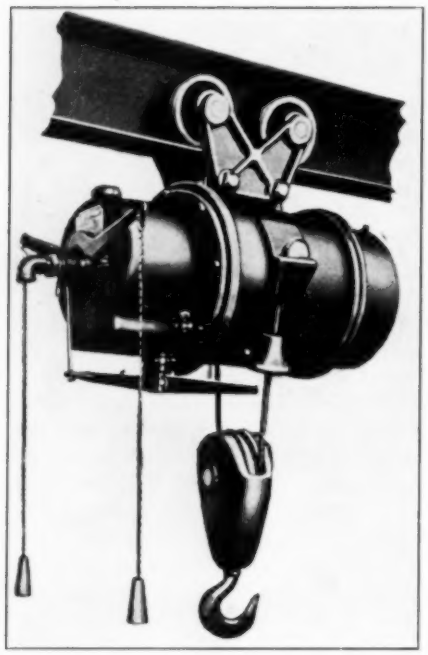
An alphabetical list of members and juniors of the assocation with a list of the members of the Canadian Society of Cost Accountants which is affiliated with the National association, and the various chapter officers for the year 1923-1924 concludes the year book.

Oil Burner Manufacturers To Hold First Meeting

The first annual meeting of the American Association of Oil Burner Manufacturers will be held at the Hotel Chase, St. Louis, April 1 to 3, according to a recent announcement. A program has been arranged with speakers of national reputation on both industrial and domestic oil burners. The association has issued an invitation to companies and individuals in allied industries to attend the series of meetings. Oil burners and oil burning equipment will be exhibited on the roof garden of the hotel.

Will Make Pyrometers

The manufacture of pyrometers will be undertaken shortly by Republic Flow Meters Co., Chicago, which is now building a two-story addition to its plant to be devoted exclusively to its new product. Modern machinery is to be installed in this addition. It is hoped to get into production in time to make shipments beginning Aug. 1. Heretofore pyrometers have not been manufactured in the Chicago district.



HOISTS BUILT IN FIVE SIZES HAVE CAPACITIES RANGING FROM 500 TO 10,000 POUNDS

New Air Motor Hoist Has Automatic Brake

The Ingersoll-Rand Co., New York, is offering a line of motor hoists, which are made in five sizes ranging in capacity from 500 to 10,000 pounds. The new hoist is designed for use in various industries where rapid and economical lifting and handling of materials is desired. A balanced three-cylinder motor is used which operates in either direction. The hoist is compact and is serviceable where low head room is encountered.

The throttle graduation of the new hoists is gradual to secure a close regulation of both lifting and lowering speeds. A safety stop lever is provided which closes the throttle whenever the load, by any chance, is raised to the top of the hoist lift. An automatic brake is designed to hold the load at any desired position regardless of the air pressure. The brake consists of a disk attached to the motor shaft and a brake plunger with a friction face which is held by springs in constant contact with the disk when the hoist is not operating. The problem of lubrication has been given special attention in designing the hoist.

C. C. McDermott, who has represented the Brown Instrument Co., Philadelphia, in Chicago territory, and E. F. Irwin, who has been factory manager of the same company, have become affiliated with the Republic Flow Meters Co., Chicago, which soon will begin the manufacture of pyrometers.

Long Conveyor Handles Molding Sands

A carrier 550 feet long with buckets 30 inches wide and hung on a chain of 24-inch pitch has been installed and is in operation at the Commonwealth Steel Co., Granite City, Ill. This carrier which was built by the Link-Belt Co., Chicago, is used in handling facing sands for the foundry. The Commonwealth Steel Co. produces steel castings for locomotive and car construction. At present four open hearths are in operation and the fifth is being constructed. Nine heats are run per day with approximately 200 tons of steel poured.

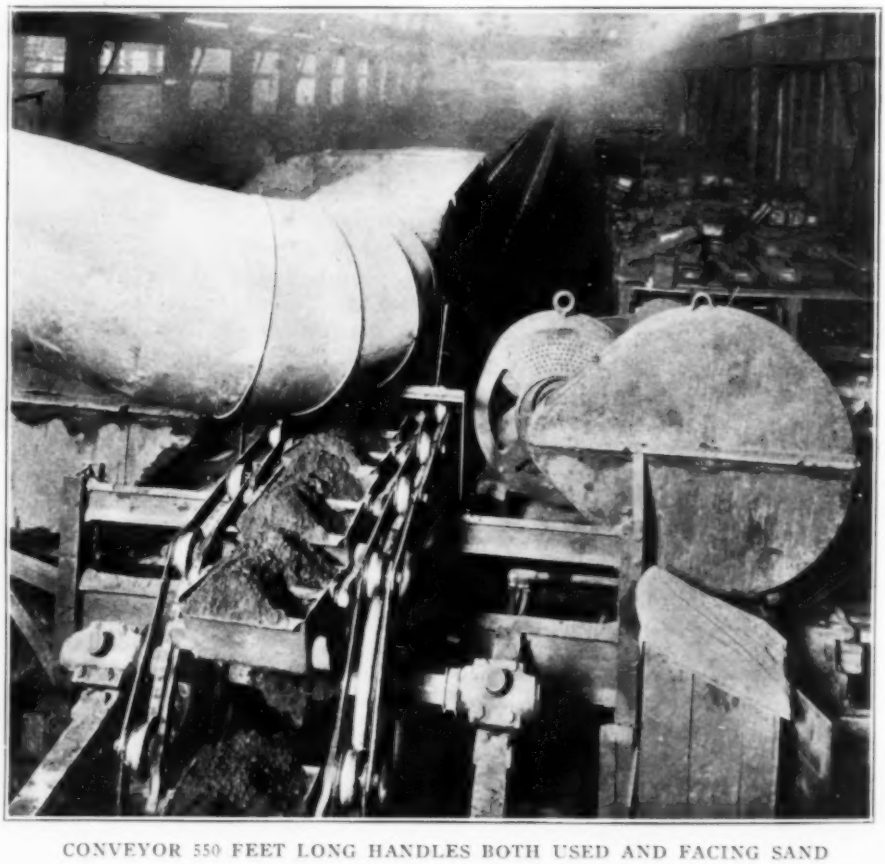
The arrangement of the conveyor which handles molding sand permits it to carry both used and facing sand. The return of the carrier runs in a tunnel under the molding floor. Gratings are placed over the conveyor and when the flasks are shaken out on these gratings the sand falls into the buckets. The sand is carried almost to the end of the foundry and is dumped on an inclined belt conveyor feeding to a crusher. From this crusher the sand is passed over a screen, then to a belt conveyor leading to the sand mills. While being transported to the sand mills, new white sand and fire clay are added automatically. After the sand has been pulverized thoroughly and mixed by the sand mills, it is discharged into the buckets of the carrier and elevated and conveyed to the hoppers over the molding boys. The conveyor requires two operators, one distributing the sand to the hoppers and the other cleaning out the tunnel. The molder receives the sand from an overhead hopper.

Before this equipment for the facing sand was installed, dump cars hauled by a narrow gage railway locomotive were used to bring the sand from the sand mills to the molder. The company has made a study which shows a considerable saving can be had by the conveyor installation. It is said that the repair costs are low. The facing sand carrier has a 25-horsepower motor but since being installed has not developed more than 10 to 12 horsepower. The capacity of this conveyor is 60 tons of sand per hour.

Buys Aluminum Co.

The Mutual Electric & Machine Co., makers of electrical safety appliances, has purchased the plant of the Aluminum Castings Co. in Hamtramck adjacent to Dodge Bros. plant, Detroit. It is understood the new owners plan to abandon their two plants in the west side of the city.

The Kensington Davis Corp., 144 Kensington Ave., Buffalo, desires to obtain warm air castings either in the Chicago district in Illinois, in Indiana, Michigan or Iowa.



CONVEYOR 550 FEET LONG HANDLES BOTH USED AND FACING SAND

Foundries Defer Purchases

Volume of Inquiry Denotes Need for Foundry Equipment in Replacement and Extension Service—Quotations Asked Against New Budgets—Automobile Plants Buy Actively

WHILE a fair volume of orders and an increasing number of inquiries are apparent in foundry equipment lines, many firms are asking quotations subject to appropriations to come. An exception is noted among automotive foundries which are buying for immediate needs. The Nickel Plate Foundry Co., Cleveland, is making plant additions and has purchased a cupola and tumbling mills from the W. W. Sly Mfg. Co., Cleveland. Other recent sales of tumbling mill equipment by the latter interest include the Industrial Steel Castings Co., Toledo, Warren Tool & Forge Co., Warren, O., Dayton Malleable Iron Co., Canton, O., Forest City Foundry & Mfg. Co. and Interstate Foundry Co., Cleveland and Standard Foundry Co., Buffalo. The Walworth Mfg. Co., Kewanee, Ill., is considering the construction of a new electric steel foundry, probably to be located in that city. The main office of the company is in Boston. Howard Coonley is president. Peck Stowe & Wilcox Co., Cleveland, will install a dust arrester, Sawbrook Steel Casting Co., Cincinnati, sand blast and dust arrester equipment and Marietta Hollowware & Enameling Co., Marietta, O., sand blast machinery, to be built by the Pangborn Corp., Hagerstown, Md. The Caloric Gas Stove Works, Topton, Pa., has contracted for a new enameling plant with the Porcelain Enamel & Mfg. Co., Baltimore.

East Notes Hopeful Condition

DEMAND for foundry equipment and supplies is slightly improved in the eastern states. Several new projects are in prospect that will carry fair requirements. Recent ladle sales of the Whiting Corp., Harvey, Ill., include units to the Nordberg Mfg. Co., Milwaukee, Taylor-Wharton Iron & Steel Co., High Bridge, N. J. The same interest will provide tumbling mills for the National cast Iron Pipe Co., Birmingham Ala., and a 21-ton cupola for the Standard Sanitary Mfg. Co., New Brighton, Pa. Central Foundry Co., New York, shortly will start to replace its foundry at Anniston, Ala., damaged by fire. The Springfield Foundry Co., Springfield, Mass., will construct a $25,000 foundry addition. The American Radiator Co., Buffalo has purchased sand blast equipment and a dust arrester installation and the Summit Foundry Co., Geneva, N. Y., a dust arrester from the Pangborn Corp., Hagerstown, Md. The Electric Furnace Construction Co., Philadelphia, has been awarded the contract for two enameling furnaces for the Buckwater Stove Co., Royersford, Pa., which contemplates extensions to its foundry

Inquiry Persistent in New England

WHILE records show that the New England foundry melt fell off slightly during February, equipment sales for the month improved over January and this same improvement has continued through the first part of March with inquiry becoming more persistent each week. Several foundry additions and alterations are under way and new equipment will be purchased. Labor saving devices are in demand and manufacturers of material handling equipment report good inquiry with sales well sustained. The Goodnow Foundry Co. at Fitchburg, Mass., bought a sand separator from the Royer Foundry Machine Co., Wilkesbarre, Pa. Another sand machine from this same company was sold to the General Electric Co. for immediate shipment to its Lynn, Mass., plant. Inquiry for two cranes is before the trade. The Rhode Island Malleable Iron Co. is looking for equipment for a plant addition which is about to be built. The General Electric Co. is increasing its brass capacity at West Lynn, Mass.

Activity Limited In Chicago Section

INQUIRY for foundry equipment coming to Chicago manufacturers continues below the general expectations held out for the early months of 1924. The bright spot in the situation is the fact that foundries in general, excepting the heavy jobbing foundries, are finding an improvement in their business. For some classes of equipment, dull times prove a boon, as the necessity for labor-saving devices is then the more urgent. Recent sales by the National Engineering Co., Chicago of their sand mixers include mixers to the International Harvester Co. for its Canton, Ill., plant, the Chattanooga Plow Works, Chattanooga, Tenn., the American Building Foundry Co., Chicago, and the American Art Bronze Foundry, Chicago. The Whiting Corp., Harvey, Ill., has placed cupolas with the board of education, Chicago, for its Tilden technical high school, the Standard Sanitary Mfg. Co., New Brighton, Pa., Lindgren Foundry Co., Batavia, Ill., the Seaboard Air Line for its shops at Portsmouth, Va., the Winslow Standard Scale Co., Terre Haute, Ind., and the Sanitary Co. of America, Linfield, Pa. In addition, this latter company has purchased two Whiting cupola charging machines and 35 charging cars.

Buick Motor Co., Flint, Mich., and Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., large automotive interests have purchased sand blast equipment from the Pangborn Corp., Hagerstown, Md. The Packard Motor Car Co., Detroit, has contracted for a dust arrester installation with the same interest. The Lakey Foundry & Machine Co., Muskegon, Mich., has purchased a room type sand blast with dust arrester equipment from the W. W. Sly Mfg. Co., Cleveland. The Ford Motor Co., Detroit, has ordered a number of additional tumbling mills from the Sly company and also has purchased 24 squeezer type molding machines from the Berkshire Mfg. Co., Cleveland. Other sales of tumbling mills by the W. W. Sly Mfg. Co., include machines for the Ottumwa Iron Works, Ottumwa, Ia., and the National Malleable Castings Co., Chicago.

Pittsburgh Expects Growth in Demand

SENTIMENT in foundry equipment lines in the Pittsburgh district, while somewhat mixed, is still of a constructive character. Some dealers report demand for miscellaneous items gradually is broadening and that more buying interest is being taken by many of the larger consumers. Many are soliciting quotations on equipment for the purpose of preparing budgets, and the feeling prevails that orders are not far distant. District sales in the Pittsburgh district include 150 flasks and a large number of wheelbarrows. The General Foundry & Machine Co., Farmers Bank building, Pittsburgh, is in the market for foundry equiment, machinery, tools, power

transmission equipment, etc., for installation in its plant which recently was purchased from the Allegheny Forging Co. Inquiry is being made by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., for two 5-ton cranes while the Standard Sanitary Mfg. Co. is seeking quotations on six 5-ton cranes for its Baltimore division. The National Plate Glass Co., Blairsville, Pa., which operates a large foundry for manufacturing glass molds, has ordered from the Whiting Corp., Harvey, Ill., one 5-ton crane, 87-foot span; one 5-ton crane, 67-foot span; one 12-ton crane with 2-motor auxiliary hoist of 50-foot span; and three 5-ton cranes of 96-foot span. It recently purchased 10 cranes ranging from 5 to 20-ton capacity for its Ottawa, Ill., plant from the same corporation. This week's orders also include a 10-ton trolley which was purchased from the Shaw Electric Crane Works, Muskegon, Mich., by the Vulcan Mould & Iron Corp., Latrobe, Pa. The Eagle Bronze Co. closed with the Whiting Corp. on a 5-ton hand operated crane for installation at its Mount Vernon, N. Y., plant. The Berks Foundry & Mfg. Co., Berks, Pa., has purchased an iron cinder mill from the W. W. Sly Mfg. Co., Cleveland. Recent sales of sand blast equipment include a unit to the Oil Well Supply Co., Oil City, Pa., by the Pangborn Corp., Hagerstown, Md.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Barnhart Davis Co., Warren, O., contemplates constructing $40,000 machine shop and foundry buildings. G. Croft is president.

National Pipe & Foundry Co., Montgomery, Ala., has increased its capital stock from $100,000 to $525,000.

Victory Foundry & Machine Co., Buffalo, N. Y., has changed its name to Washington Iron Works.

Springfield Foundry Co., Oak street, Springfield, Mass., has let a general contract for $25,000 plant addition to L. S. Wood.

Chester S. Hathaway has received the contract for constructing 1-story foundry addition at 25 Elm street, New Bedford, Mass.

The Jakes Foundry Co., Nashville, Tenn., has been incorporated for $100,000 by Robert, E. F., J. W., Claude, B, James T. and P. W. Jakes and Robert Jakes Jr.

Doehler Die Castings Co., Brooklyn, N. Y., has purchased the die casting department of the Light Mfg. & Foundry Co., Pottstown, Pa.

National Bronze Foundry, Buffalo, N. Y., has been incorporated for $10,000 by H. P. Gould, V. Reiss with M. M. Yellen as attorney.

Hershey Machine & Foundry Co., Manheim, Pa., has prepared preliminary plans for a 1-story machine shop addition. R. K. Hershey is president.

Acme Brass Foundry Co., Inc., San Antonio, Tex., has been incorporated for $2500 by G. C. Frank, Steve and Herman Margozewitz.

Warren Foundry Sand Co., Seattle, has been incorporated for $40,000 by W. R. Tompkins, E. A. Strout and Robert Niedergesscss.

Equipment is being purchased for the Jenkins Machine Co., 315 North Eighth street, Sheboygan, Wis., for 1-story foundry under construction. A. Stuedemann is president.

Rosenthal Corn Husker Co., 7424 Elm street, West Allis, Wis., operator of gray iron foundry, plans 1-story foundry on Greenfield street, at an estimated cost of $40,000.

Guay, Savoie & Cie., Plessisville, Que., operator of a gray iron, brass and aluminum foundry, is in the market for foundry and shop equipment, including lathes, flasks, presses, etc.

The Buckwalter Stove Co., Royersford, Pa., operator of a gray iron foundry, has awarded contracts for erecting a new enameling plant, 100 x 300 feet, to Beling-Bush Co., Inc., Drexel building, Philadelphia.

The Burr Foundry & Machine Co., Boston, has been incorporated for $65,000 by Shields Burr, of Newton Highlands, Mass., David E. Burr, Cambridge, Mass., and Charles R. Cabot, Brookline, Mass.

Oxford Foundry & Machine Co., Oxford, N. S., operator of a gray iron foundry, plans a machine shop to replace that recently damaged by fire and is interested in purchase of machinery and tools.

The Bellingham Steel & Brass Co., Bellingham, Wash., recently incorporated, plans to start production soon of brass and steel castings. Electric furnaces have been purchased. W. A. Deming is interested in company.

Central Foundry Co., New York, plans reconstructing its foundry at Anniston, Ala., recently damaged by fire. Considerable new equipment is to be purchased. E. P. Cooper is manager of the Anniston plant.

Clover Foundry Co., Clay and Eleventh streets, Muskegon, Mich., plans 1-story, 60 x 168-foot brick foundry building addition, costing about $30,000. Charles S. Clover is president.

E. E. Jacobs who recently bought the Athens Foundry & Machine Co., Athens, O., has sold the property to David L. Wallace, Nelsonville, O. Extension of plant and installation of additional equipment is planned.

The St. Louis Steel Casting Co., 3432 Potomac street, St. Louis, is to begin production in the latter part of March. The company recently was incorporated with Joseph Teipel as president, W. F. Exner as secretary and F. G. Lanbern as treasurer.

Alliance Foundry Co., Alliance, O., recently incorporated, has purchased a plant and started converting it into a foundry. High quality gray iron castings up to 5-ton size will be produced. J. J. Hutmacher is general manager.

The Nickel Plate Foundry Co., Woodworth and Coit roads, Cleveland, plans 1-story, 96 x 160-foot foundry, costing about $50,000. Construction contract has been let to Lane Construction Co. H. M. Morse & Co., Finance building, Cleveland, is architect.

The Hoover Suction Sweeper Co., North Canton, O., has awarded construction contracts for 4-story, 80 x 300-foot factory, 114 x 115-foot dyehouse, foundry and administration building costing approximately $1,000,000.

The Bowler Foundry Co., 1688 Columbus road, Cleveland, will take bids about April 1 on construction of a 90 x 200-foot foundry, 100 x 185-foot pattern shop, 35 x 45-foot garage and 40 x 160-foot cleaning and shipping department building. A. G. Simon, Hippodrome building, Cleveland, is engineer. The report that Ernest McGeroge is architect, as carried in THE FOUNDRY, March 1, was in error.

The Ben Sibbitt Iron Works has purchased the plant and business of the Wichita Foundry Co., 525 Wichita street, Wichita, Kans., and will move the stock and equipment of the latter company to the Sibbitt works at 217 Moore avenue.

Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill., has let general construction contracts for a $300,000, 1-story, 202 x 258-foot brick and steel foundry building. Hughes Foulkrod Co., Oliver building, Pittsburgh, is general contractor. The Mt. Vernon company operates a gray iron foundry.

Mitchell Brass Foundry, Ltd., Mercer and Hanna streets, Windsor, Ont., has been incorporated to acquire and take over the plant and business of the Mitchell Brass Foundry, operator of a brass and aluminum foundry. New company is capitalized at $45,000. Charles F. Mitchell is manager and Charles H. Mitchell, superintendent.

New Trade Publications

FOUNDRY DESIGN—Frank D. Chase, Inc., Chicago, sets forth in a well illustrated pamphlet a series of foundries "that fit." Reasons for adopting a careful design for new foundries are discussed.

LABORATORY SERVICE—The Keighley Laboratories, Ltd., Keighley, England, have issued an interesting series of postcards illustrating the structure of cast iron and steel. Instead of being printed, the cards display actual photographs, showing internal chill in gray iron, graphite structures of gray iron, distribution of graphite in malleable iron, and the effect of heat treatment on the structure of steel.

CUPOLAS—The Whiting Corp., Harvey, Ill., has issued a 48-page booklet describing its cupolas. The construction of various parts, erection and operating directions, adaptability, sizes and capacities, are described as are the many cupola accessories built by this company. The last half of the book is devoted to the mechanical charging of cupolas and the storage of materials to be used in the foundry. The booklet is well illustrated with views of the cupolas and installations of material handling equipment both for storage and charging.